ENGINEERING AND MINING JOURNAL

JUNE, 1943

...TING ROOM of Electrolytic Division of American Zinc ... of Illinois. The furnace that holds the molten cathode ... is in the rear

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In this issue LONGHORN TIN—Wartime Problem Solved
MINING LOAN POLICY OF RFC—Charles B. Henderson
Bagdad—Arizona's Latest Porphyry Copper
Proper Draw-Point Spacing in Block Caving
Rough Milling Lengthens Platteville District's Life
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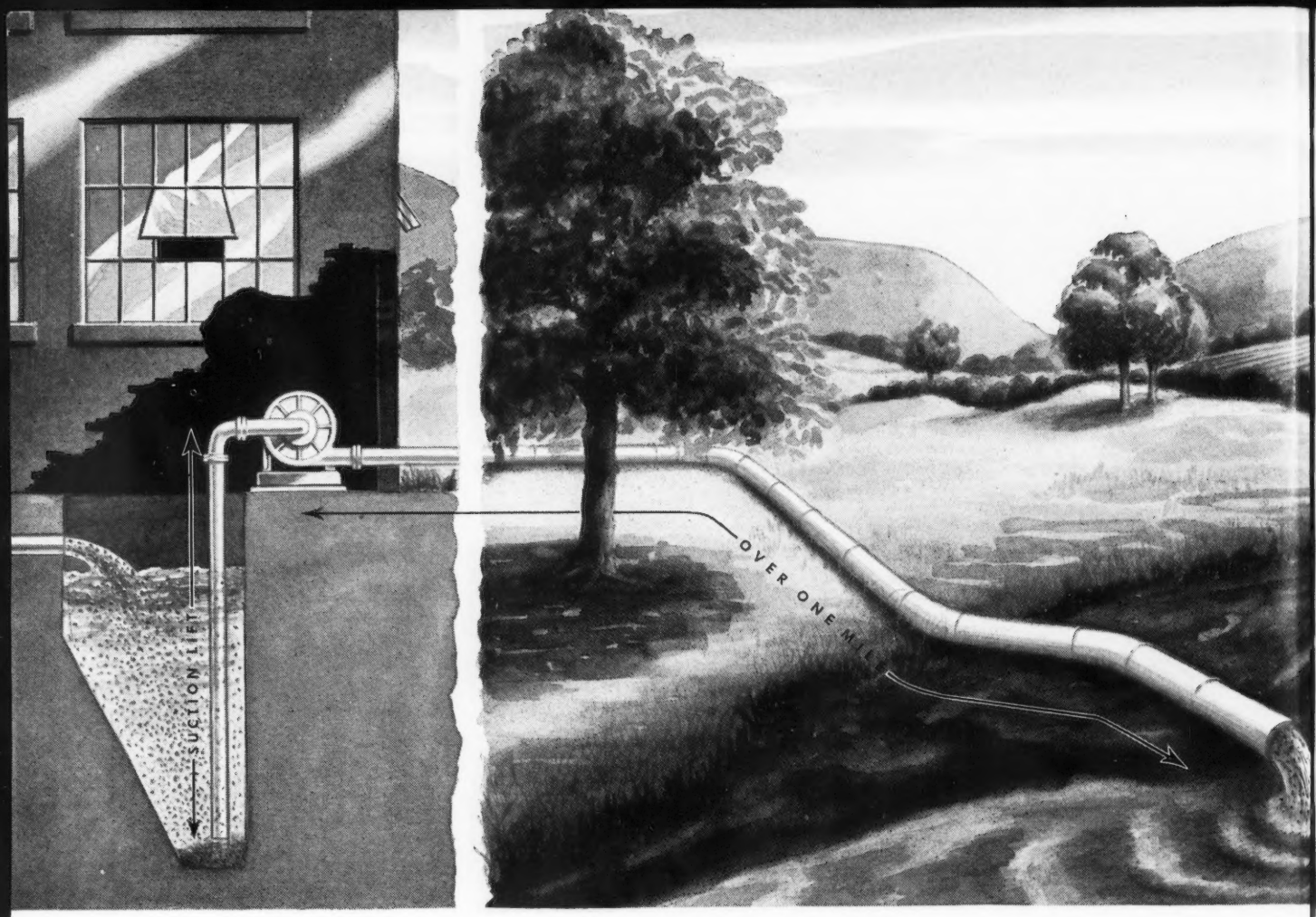

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Midyear approaches and with it the July *E.&M.J.* Here, close to the halfway mark, the outlook is brighter than it was 12 months ago. The initiative rests definitely with the United Nations, and to help them keep it even as they helped them get it, the metal mines are rolling out the tonnage, for the mills and smelters to reduce, and the non-metallic producers are also on the job.

▼ ▼ ▼

And E.&M.J. is rolling out the articles and the news. Its aim is to make this material helpful and worth the attention of the reader—at a moment when everyone is pressed for time. The censorship has made difficulties for editors. Its complexities are getting simpler—we hope. A magazine such as this, with a foreign as well as domestic circulation, has had to watch its step more closely than has the purely domestic publication.

▼ ▼ ▼

Topics for the July number include, among others: 1, A discussion of blast-furnace operating difficulties and an improved design of furnace which, it is thought, will do away with them. 2, The air lift and its usefulness in unwatering shafts and ground for mining. 3, The world's largest dredge—a new Yuba boat. 4, Current operations at the Morenci unit of the Phelps Dodge Corporation. 5, The question, when should a rock drill be discarded?

▼ ▼ ▼

Congestion of postal and transportation facilities is causing some delay in delivery of *E.&M.J.* If you do not receive your copy as usual please wait a reasonable length of time before entering a complaint, and thus lighten the load of correspondence in our circulation department. The publishers are making every effort to print and mail on time, but cannot wholly avoid the difficulties resulting from the war. Your understanding and cooperation will be appreciated.

ALFRED M. STAEHLE
Publisher

ENGINEERING AND MINING JOURNAL

R. M. WARD
Manager

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H. C. PARMELEE
Editor

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COVER ILLUSTRATION: CASTING ROOM of Electrolytic Division of American Zinc Co. of Illinois. The furnace that holds the molten cathode zinc is in the rear

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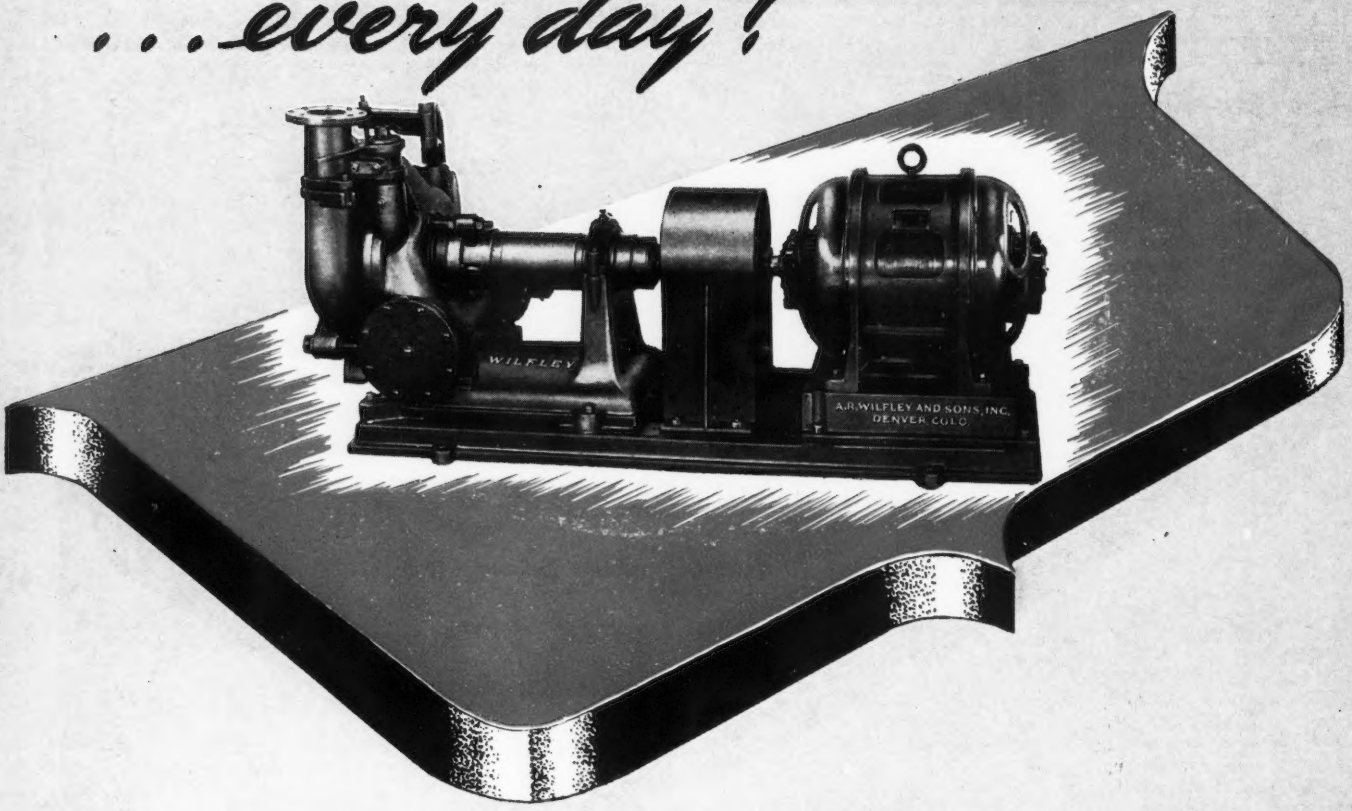

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Electrical Equipment—Weapons and Tools

From miniature motors to mammoth generators, from tiny detector tubes to great broadcasting stations—everything electrical is essential to our war effort

AS this editorial goes to press, newspapers and radio news commentators are telling the dramatic story of the blasting of two mighty Nazi power dams. Floods are sweeping down the Ruhr Valley, Germany's most vital munition production center. Two vast networks of industrial activity lie inert, for the great generators that had fed power to hundreds of plants producing war goods for Hitler, today stand idle. This daring raid will go down in history as one of the most, if not *the* most devastating of the entire war. It has destroyed two great sources of power, stopping the wheels in hundreds of plants and throwing into darkness thousands of factories and homes.

This epoch-making raid by the R.A.F. brings home to us the vital importance of our own power resources, those colossal generators from which flows the current that turns the wheels of our great industries, illuminates our factories and homes and runs our electric railways and subways. It makes us realize how dependent we are on electricity and how important is the part of those manufacturers who produce the electrical equipment that makes possible its generation and use.

Beginning with Thomas A. Edison, the inventive genius of electrical manufacturing men has devised more and more efficient ways of generating the current, better and better means of transmitting it and of applying it to do thousands of jobs quicker and better.

The products of electrical manufacturers have become so completely an essential component part of every industrial, business and domestic activity that our economy and our war effort could not go on without it.

In days of peace the laboratories of our electrical industry gave us radio, fluorescent lighting, infra-red drying, precision process-control, telemetering, split-second circuit breakers and many other things that border on the miraculous.

Today their facilities and their genius are devoted to an all-out war of wits with Axis scientists and production men.

Electricity plays a significant part in this war . . . from the "walkie-talkie" that brings support to hard-pressed outposts, to the mammoth motors on the battleships. While many electrical developments today are cloaked in secrecy, the nation will enthusiastically applaud these electrical manufacturers when the curtain is lifted.

The far-reaching importance of electrical instruments, apparatus and machines becomes evident when we consider that over 350 different electrical items go into combat vessels and that more than 170 go into a fighter plane. Most of these products are distinctly special in nature and are far removed from their civilian counterparts if, indeed, they have such counterparts.

To the civilian, a light bulb is something so standardized that every need can be filled by any nearby dealer. Our armed forces, by contrast, must have at their disposal more than 400 distinct types of lamps. Some no larger than the head of a match, are so brilliant that they flash signals under a tropical noon sky. Others are built to withstand extremely low temperatures, vibration, shock and many other abuses to which they are subjected.

On planes, for example, numerous fractional-horsepower motors are used but the standard industrial motor is not suitable for this service. New records in low weight-per-horsepower had to be achieved involving extensive changes in design and production.

To prevent the light from instrument panels from impairing the vision of night fighters, ultra-violet radiation which activates fluorescent instrument dials was developed. As a result, the pilot may look out into the darkness after reading his instruments without the least effect on his eyes. How many precious air victories can be credited to this one development alone?

But, in general, the story of this industry's war work is much too blurred by military censorship to afford an adequate picture of its contributions. The factories and shipyards that are turning out war matériel tell a more complete story. Many of these have been built during the past two years. Others have gone through a complete conversion process. In every case, large quantities of electrical materials were involved.

In the broadest sense, there are three major jobs which this industry has had to do, in addition to equipping our modern war machine. It has had to supply materials for the vast expansion of our industrial system, keep every plant fully maintained, and provide the necessary equipment for the vital power and communication fields.

More than $1,900,000,000 was spent for new industrial construction in 1942, and of this about 7% or $140,000,000 was for electrical materials. New machine tools and other production equipment required an additional $350,000,000 worth of electrical products. The conversion program called for another $145,000,000 of electrical apparatus and supplies.

This total of over $600,000,000 in itself would have staggered the electrical industry in a peace-time year. Yet, this record-breaking production was essential and had to be superimposed upon the direct requirements of the Army and Navy.

Industry depends upon electricity. Consider for a moment the effect of modern lighting upon war production. Industry enjoys levels of illumination and color quality that were undreamed of ten years ago. As a result, midnight shifts operate at daytime efficiency. As a matter of fact, many of the more modern plants have no windows at all.

Then there is maintenance. The failure of one single motor or feeder will stop a production line. Electrical manufacturers have had to stand at all times ready to

supply the heavy demand for the maintenance and repair parts that keep our industrial machine operating at top speed. Excess loads, 24-hour schedules and inexperienced production hands combine to shorten the lives of electrical equipment.

Electrical manufacturers have had to supply the greatly expanded needs of our power and communication systems.

New construction of all sorts — war plants, cantonments, war housing — has created a formidable need for additional capacity. Every element in our domestic economy has called for increased communication and power services. All this had to be superimposed upon the vast demands of our armed forces. The magnitude of this task is obvious but it is being successfully accomplished. Every old installation is functioning smoothly and every new one has been ready to function on exact schedule. There has been no failure either in our power or in our communication. Part of the credit for this performance belongs to the hundreds of manufacturers who delivered their products when and where they were needed.

This was not merely a problem of increasing production. These manufacturers had been depending on rubber, copper, aluminum and steel — all highly critical materials. For much of their non-military production they suddenly had either to find substitutes or practice the utmost economy and ingenuity.

This is the twelfth of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers, and in daily newspapers in New York, Chicago and Washington, D. C. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public on the magnificent war-production accomplishments of America's industries.

Solutions to many problems were quickly found. Lighting manufacturers greatly reduced their use of steel by designing efficient, non-metallic reflectors. Wire and cable manufacturers expanded their use of synthetic insulation in place of rubber and they promoted the use of higher distribution voltages so that every ounce of copper would work more efficiently.

Steel is essential in apparatus that operates magnetically. There is no known substitute. But marked economies in its use have been achieved through the development of new alloys that are of increased magnetic efficiency. As a result, motors and transformers now consume substantially less steel than did units of equal capacity a year or two ago.

Electrical manufacturers have given our industries numerous new production tools. Infra-red heating tunnels, for example, have drastically reduced the time involved in production drying . . . in some cases from hours to minutes. High-frequency induction-heating has been spectacularly successful in the forging, brazing, hardening and casting of ordnance. Modern welding equipment makes possible speedy production with inexperienced labor.

America's production lines are being patrolled by electrical devices which eliminate human error. One million volt X-ray equipment looks through castings and points an unfailing finger at defects. An electronic flaw detector tests nonferrous drawn-metal tubing for imperfections. Other electronic devices are counting and sorting the products of thousands of war plants. Precision controls regulate all sorts of processes, from aluminum production to armor plate annealing.

These are but a few of many examples of the way in which the magic power of electricity has been harnessed to the war effort. Back of every development there is at least one electrical manufacturer — more often many — who have pooled ideas and methods with no thought of royalties or dispute over cost allocation.

No story of the electrical industry would be complete that did not pay tribute to those manufacturers who have dropped their normal lines in order to produce special war products. Many appliance manufacturers fall in this group. When war came, they did not stop to argue that civilian morale and big pay checks would demand a continued supply of their products, instead they quickly shifted to the production of war matériel and today they are deep in the manufacture of machine gun parts, aircraft sub-assemblies, and even gas-mask fabric. They have had to abandon their hard-won markets for the duration; but they are contributing mightily to permanent peace and a more prosperous world to which they will return when the guns are silenced.

This great industry has increased its production threefold in two years — $2,500,000,000 in 1940 to $7,500,000,000 in 1942. It has done this with all the zest of youth, for this is a young and a pioneering industry. Few companies in this industry are fifty years old; the majority are much younger. Top management in general is young, too, and many outstanding technical developments have come from the brains of men just a few years out of college.

The results of all its intensive intelligent work can be found in every factory, on every battlefield and ocean, and even in the flak-spotted air over Berlin. In a sense, the electrical manufacturing industry stands beside every soldier and every sailor as he goes into action. It has a place of honor it richly deserves.

And when this war passes into history, as it surely will, our soldiers and sailors returning to peace-time jobs, will find a life greatly enriched by electrical developments that were undreamed of yesterday.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

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H. C. PARMELEE, Editor

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VOLUME 144 — JUNE, 1943 — NUMBER 6

"Seed Money" for Mining

IT IS EVIDENT from our news columns that responsible mining men all over the world are becoming seriously disturbed over the probability that burdensome taxation will wreck the industry's capacity to perpetuate itself. Unfortunately, the public and its legislative representatives have never realized the full impcrt of wasting assets, the rapidity with which the industry is losing ground in regard to reserves, or the length of time which normally elapses between setting out to explore and the actual mining of such reserves as are thus discovered.

This problem is world-wide, but actually worse in the United States than in Australia, South Africa, and Canada, which are giving it more serious consideration. Canada's depletion of its mineral resources is certainly far less advanced than is the case in the United States. Therefore it may serve to wake up this country to read the following statement from the annual report of J. P. Bickell, president of McIntyre Porcupine Mines, Ltd.:

"The real prospector has a yearning to battle with Nature. He is willing to gamble on an all or nothing basis. He accepts the hardships and the privations of his calling without complaint, but he doesn't look upon his life in the bush as a form of recreation. Always in his mind's eye is the big prize, the great discovery; that 'something' that will bring him financial security and independence.

"Today he knows, and we, active in the industry, know, that the prize has, for all practical purposes, been eliminated.

"Year after year the impact of taxation has increased until today the various governing bodies have imposed taxation—corporate and personal—upon an industry drawing sustenance from wasting assets, to a point where such industry cannot survive and hope to perpetuate itself. That portion that remains for the shareholders, after corporate taxes are paid, is so raked fore and aft for Income Tax and Succession Duties, that, in the final analysis, he who ventures, he who has the fortitude and desire to utilize the resources Nature put at our disposal, realizes beyond question or argument that the odds against him are insurmountable. The industry then is on a salvage basis and must continue to shrink until the taxing authorities realize that they have long since reached the era of diminishing returns.

"Only those who believe in present-day miracles can dispute this analysis. Some may contend that everything will be corrected as soon as the war has been won. To the latter it should be pointed out that it usually takes from three to seven years to bring a worthy prospect into production, and the interval suggested does not include the time required to make the original discovery.

"If there be some who would argue to the contrary, let them seriously examine the following facts: Fifty-six percent of Canada's current mineral production is coming from mining areas discovered prior to 1910; 28 percent from discoveries between 1910 and 1920; 11 percent from discoveries between 1920 and 1930; and only 5 percent from discoveries made since 1930.

"To anyone open to conviction, surely the handwriting is on the wall."

Progress of War Production

ITEMS IN THE DAILY PRESS announcing the cutback or cancellation of war contracts begin to reflect the changing status of war production. Not that peak volume has yet been reached, or will be reached until early fall; but rather that parts of the whole program have now been completed, or that the "fluidity of war" is shifting emphasis from one weapon to another—say from tanks to airplanes.

Industrial production is now satisfying about 90 percent of the demands of our war economy, so that we have not much further to go to fill the pipelines and provide a steady flow of munitions from factory to battle front. That flow will continue at a high and constant level until Germany is knocked out of the war. At that time we may expect to see a drop in production to a lower level that will be sustained until Japan is defeated. Thereafter will come a final decline as industry returns to peacetime pursuits.

Meantime many adjustments will have to be made in the slow and difficult process of reconversion from war to peace. That process has already begun. The War Production Board believes that, except for one or two items like high-octane aviation fuel and synthetic rubber, no new manufacturing facilities need be built. Likewise, the production of machine tools can be stopped rather abruptly. Some plants that were converted to war production must now be reconverted, not to their original output but to some new munition still inadequately produced. All of these shifts are being reflected in temporary and

spotty unemployment and other economic dislocations. They give a foretaste of the inevitable and painful transition period which must be experienced before industry can get back into its stride and accept the challenge of postwar prosperity.

In all of this, however, the mining industry can see little relief from its present program of maximum production. It must continue to the end, despite the prospect of stockpiles and inventories when peace comes. Regardless of shifts in production of matériel, the demand for metals and minerals will continue to put a strain on the resources of the industry until the enemy is conquered.

Nose in the Tent

THEY IN GOVERNMENT who would undermine private enterprise by the Raushenbush doctrine of "encroaching control" in order to enlarge their own bureaucratic powers are very persistent and never seem to sleep. The latest manifestation of their ambition and influence seems to be Senate Bill 33, which, we warn the industry, has already been quietly slipped through the Senate and is now before the Committee on Mines and Mining of the House.

This bill would grant to the Secretary of the Interior, through the Bureau of Mines, power to establish and operate such sampling plants and custom mills for the sampling and treatment of ores of strategic and critical minerals as he deems appropriate. No curbs are placed on the discretion of the Secretary as to the number or size of such plants or their location.

In approaching this matter it is fair for the industry to ask itself and Congress if private enterprise and the emergency agencies of government are falling down on the job of providing such treatment facilities as are indicated in the public interest. In short, what is the justification for this bill? Is private enterprise failing to provide adequate treatment points or to pay promptly for shipments? In the case of emergency production not classifiable as economic, and therefore scarcely adaptable to private enterprise handling, the RFC has financed numerous plants and has set up premium price schedules and a host of receiving depots for the purchase of strategic and critical minerals. Wherein have these services failed to satisfy the public interest or the needs of the war emergency? In case any complaints are justified, why should they not be met by modification of the present system rather than by new duplicating functions being set up in the department which harbored Raushenbush?

To those in the industry who believe that their immediate interests would be served by the passage of this bill, we suggest that they ask themselves if the cure may not be worse than the disease, if the cost is to give over part of the industry's essential functions to the ambitious but wasteful and inefficient bureaucracy that stems from Washington.

To the constituents of Senator McCarran, who sponsored this bill, we suggest that they make it their business to find out the background behind this affair. Whether the bill originated with the Senator, in the Interior Department, or from some constituents disgruntled with the present order, it can at least be criticized as delegating broad and possibly dangerous powers in a very loose fashion.

Air Transport and Mining

THE MINING INDUSTRY has a double stake in the development of air transport: (1) as a market for metals; (2) as a means of accelerating mineral exploration and carrying men and cargo to and from isolated mining operations. Accomplishments of air transport thus far are generally conceded to be only a forerunner of postwar developments that will grow out of military operations in the air.

Although one plywood plane is already under flight test as a short-route cargo carrier, and two other planes are being designed and built for that purpose, there is no reason to believe that the lightweight metals will be displaced as the principal materials for airplane construction. Aluminum alloys are now dominant and will be in plentiful supply after the war. Developments looking toward the use of magnesium for the construction of cargo planes are still in the experimental stage, but the idea is considered sound and likely to evolve in the next few years. On the whole, air transport promises a major peacetime outlet for the light metals, production of which has been multiplied many-fold for military purposes.

Current air cargo operations are not efficient, because the planes were originally designed for passenger or bomber use. No planes originally conceived solely for carrying cargo are yet in regular service. Nevertheless, some remarkable records of global flight have been made, testifying to the safety and reliability of air transport. Block mica has been flown to the United States from India; platinum from the Persian gulf; beryl, quartz crystal, industrial diamonds, and mica from South Africa. Tin and tungsten in substantial tonnage have been flown out of China to India.

Of special interest to the mining industry is the perfection of the helicopter or some form of rotating-wing airplane. The ability of such craft to land and take off vertically augurs well for express and passenger service to mines located in rugged country where conventional landing fields cannot be built.

It would be unrealistic to accept optimistic statements about air transport driving other forms out of business. It will not, and can not; but it will offer unquestionable advantages for speed, for high-value cargo, and for reaching isolated places.

Reflections from Washington

Washington News Bureau

PEAK of war production is to be reached in the fourth quarter of this year. The general production curve will continue to rise until some time in the fall, when it is expected to level off for the duration. From now on, one of the major problems will be to expand production of raw materials to meet the additional requirements of the mills and factories making military items.

Top-ranking WPB officials are worried over the public reaction to cutbacks in tank and munition programs and to such announcements as that machine-tool production is due to be curtailed. It is feared a general feeling that "we are over the hump" will have an adverse effect on the quantity of goods turned out. There is evidence of such a public frame of mind.

Washington officials know that the supply of materials and critical common components will scarcely meet actual requirements until some time after the production peak has been reached. To insure proper distribution of the scanty supplies there is to be further scheduling, not only of raw materials but also of critical components and facilities. Raw-material production has been stimulated by price revisions, the opening of new mines, efforts to provide more labor for mining, and many other actions to assist mine operators.

Tighten Scheduling System

WITH CMP just about through its trial run and scheduled to become mandatory July 1, WPB has come up with two new devices, both of which represent further steps in the evolution of materials control. The more formal of these is the Component Scheduling Plan, which will see to it that the supply of critical common components is geared precisely to the supply of scheduled end products. Considerably less formal, and currently less complete, is a preference rating system for facilities. This device is aimed at preventing the use, for relatively non-essential work, of facilities needed to meet a more essential, scheduled program.

The Component Scheduling Plan exists in fact, although as yet it has no directive in the sense that the Controlled Materials Plan has. Orders placed after June 1 for the components affected by the plan must go through the WPB industry divisions which handle such components. It will be the duty of these industry divisions to see that the component production schedules match up both in quantity and delivery dates with the production schedules of end products. A favorite explanation of CMP was based on the futility of allocating steel for fifty tanks unless rubber and steel for 100 tracks also was allocated. Applying this reasoning to CSP, it becomes immediately obvious that production of 50 internal combustion engines, which are controlled components, is merely a waste of time unless, at the proper point in their production, the manufacturer gets 50 crankshafts, which are sub-components.

The facilities preference rating scheme has hardly taken recognizeable shape thus far, publicly at least. It has been announced merely that a system of preference ratings for use of facilities has been authorized, and that "appropriate administrative orders and directives" will be issued. For the present at least, these "equipment priorities" will be confined to contracts calling for fabrication or processing rather than for delivery to an ultimate consumer, to contracts calling for use of equipment in essential construction not involving delivery of materials, and to contracts for use of facilities for repair and maintenance of plant or equipment of essential producers.

New Super-Agency

AT THE END OF MAY President Roosevelt announced the creation of a new Office of War Mobilization to unify the work of the war agencies concerned with production, procurement, transportation, and distribution of military and civilian supplies, materials, and products. The new office is directed by Justice James F. Byrnes, who has full power to act, subject only to the will of the President. An advisory War Mobilization Committee consists of Fred M. Vinson, federal judge and former congressman from Kentucky, who succeeds Mr. Byrnes as Economic Stabilization Director; Secretary of War Stimson, Secretary of the Navy Knox, Harry Hopkins, chairman of the Munitions Assignment Board and Presidential confidant; and Donald Nelson, chairman of WPB.

The creation of this new office was announced with a naïve statement by the President: "We are entering a phase of the war effort when we must streamline our activities, avoid duplication and overlapping, eliminate interdepartmental friction, make decisions with dispatch, and keep both our military machine and our essential civilian economy running in team and at high speed."

The outlook for streamlining by the new agency seems dubious. It merely reshuffles men who have been accessible to one another, and does not add the priceless ingredient, a final authority which can say "No" and mean it.

SWPC Mining Loans

STATEMENT that mining loans are to be made by Smaller War Plants Corp. which appeared in the fifth report of the activities of that organization will probably not fulfill the implication that SWPC is about to take over the function of the RFC in making emergency mining loans. The intention of SWPC as stated in that document reads: "The Corporation is now making loans to small mining enterprises. Wherever a small mine has a demonstrable available production which may reasonably be economically exploited in time to be of benefit to the war effort and where it can show good management and competence to perform in the production of some mineral necessary to the war or essential civilian needs, we stand ready to provide the necessary finances for enabling the enterprise to produce."

The report also states that "the Corporation has authorized its regional loan agents to approve loans for $25,000 or less without referring them to the Corporation's office in Washington, D. C."

In May it was pointed out to the chairman of SWPC that it would be next to impossible for the local loan agents to authorize loans for mining enterprises without the aid of a competent technical staff. The result was the announcement that mining loans hereafter will be made through the Washington office of the Corporation instead of the field offices. "The availability of the Bureau of Mines, the interest of the Scrugham subcommittee and other factors caused the Corporation's directors to conclude that mining loans can be considered and

(*Continued on page* 85)

LONGHORN TIN

A War Problem Solved

New Texas smelter handling lowest grade concentrates from Bolivia

R. H. Ramsey *Assistant Editor*

BECAUSE both our military and our civilian economies depend heavily on tin and tin-plate, and for the reason that Japan owns temporarily the world's best sources of supply of the metal, we have been forced to mine tin wherever, and in whatever condition, we could find it. We have furthermore launched on a large scale an industry new to the Western Hemisphere—namely, the smelting of tin. In our new Longhorn Smelter, down in Texas, the Tin Processing Corporation has made metallurgical history by recovering tin from low-grade Bolivian ores heretofore untouched, and sufficient capacity will eventually be installed to provide for all our needs of the metal. This was not, however, a strictly local development; construction of this first large tin smelter in the United States was based to a certain extent on experience gathered in a tin smelter once operated in the Netherlands.

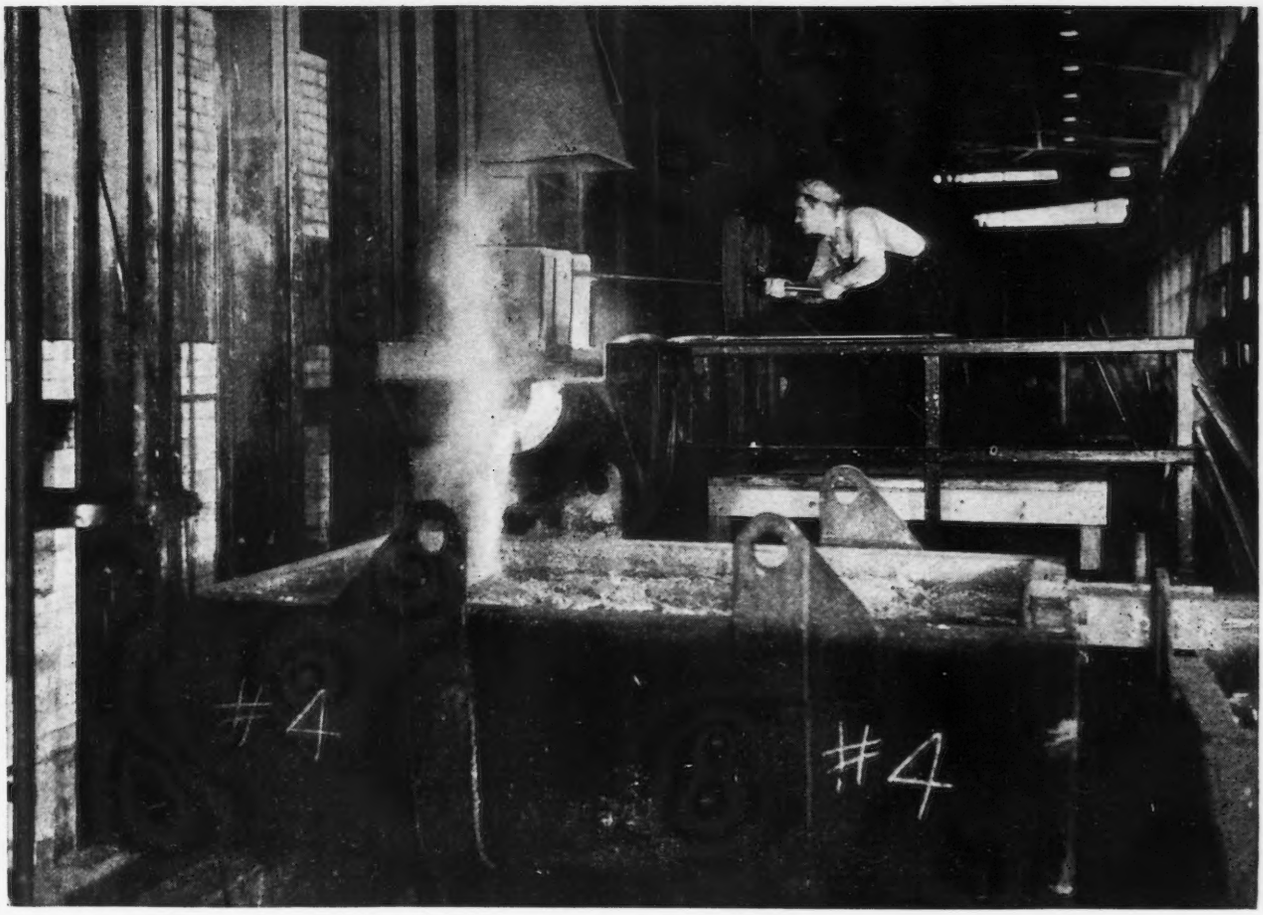
In 1927 a group of Dutch and German industrialists organized a small company to develop methods of smelting lower-grade tin ores. This company was not successful, and after two years of operation, the plant, built in Arnhem (a Dutch town on the river Rijn near the German frontier), was taken over by an affiliate of the Billiton Company and the German elements were eliminated. Just for the record, the name of the new affiliated company was N. V. Hollandsche Metallurgische Bedrijven, which, when you know how, is just as easy to say as, for example, United States Smelting, Refining, & Mining Co. The letters N. V. stand for Naamlooze Vennootschap, the Dutch expression for a company with limited liability.

The Billiton Company, the Dutch name of which is N. V. Billiton Maatschappij, was founded in 1860, and in that year took over private mining interests on the island of Billiton, in the Dutch East Indies. The Billiton Company in later years became a holding company, and mining operations were carried out by affiliated companies. Organizer of the Hollandsche Metallurgische Bedrijven was J. van den Broek, at that time managing director of the Billiton Company and at present Minister of Finance to the Dutch Government in London.

Under the Billiton Company's direction, the Arnhem smelter was developed to a point where low-grade ores, containing many more impurities than the high-grade alluvial ores from the East Indies, could be smelted satisfactorily. On this experience the design of the Texas smelter was based, but at many points in the plant American practice was adapted.

Following the invasion of Holland, our own Metals Reserve Company, one of the affiliated companies of Reconstruction Finance Corporation, began assembling stockpiles of various metals, among which tin was of great importance. In addition to the stockpiling of tin, an agreement was made with Bolivian producers in November, 1940, under which tin concentrates were to be bought from Bolivia. In addition, the Metals Reserve Company entered into a contract by which it obtained a considerable amount of pure alluvial ores from the Netherlands East Indies, and as a result of this foresighted policy, the United States had a large stockpile of tin and tin concentrates when the Japs attacked us. It might be of interest to add that the last shipment of tin ore from the East Indies reached the United States in July, 1942, after a rather adventurous trip.

A domestic tin smelter was also planned by Metals Reserve Company as a corollary of its stockpiling program; and, because of its success with the Arnhem smelter, the Billiton Company was invited to design and operate the new plant. After a series of conferences, agreement was reached on Feb. 5, 1941, and the Tin Processing Corporation was organized to begin work on the smelter at once. As a



TAPPING A REVERBERATORY FURNACE in the new smelter of Tin Processing Corp. in Texas. First large tin smelter in the Americas, this plant is also the finest of its kind in the world All photos used in this article are OWI photos by Hollem

part of this agreement, the Billiton Company guaranteed a certain recovery, and also to keep within certain cost limits, in producing tin. Exact figures may not now be given, but it may be told that not only have costs been kept within the limits set; they are constantly being reduced as the staff acquires experience and more material becomes available for plant mechanization. Actual building of the plant, now known as the Longhorn smelter, started in October, 1941, and the first tin ingots were poured on Easter Sunday, April 5, 1942.

Three factors made Texas the logical place for the tin smelter: first, was the abundance of hydrochloric acid, a waste product of certain nearby plants; second, was the abundance of natural gas, of which the Longhorn smelter uses about a million cubic feet per day; and third, was the shorter and safer route between a Texas site and the Bolivian sources of ore. HCl is used in leaching impurities out of the low-grade ores, which means practically everything the smelter handles. Natural gas is of course burned in the kilns and the reverberatories.

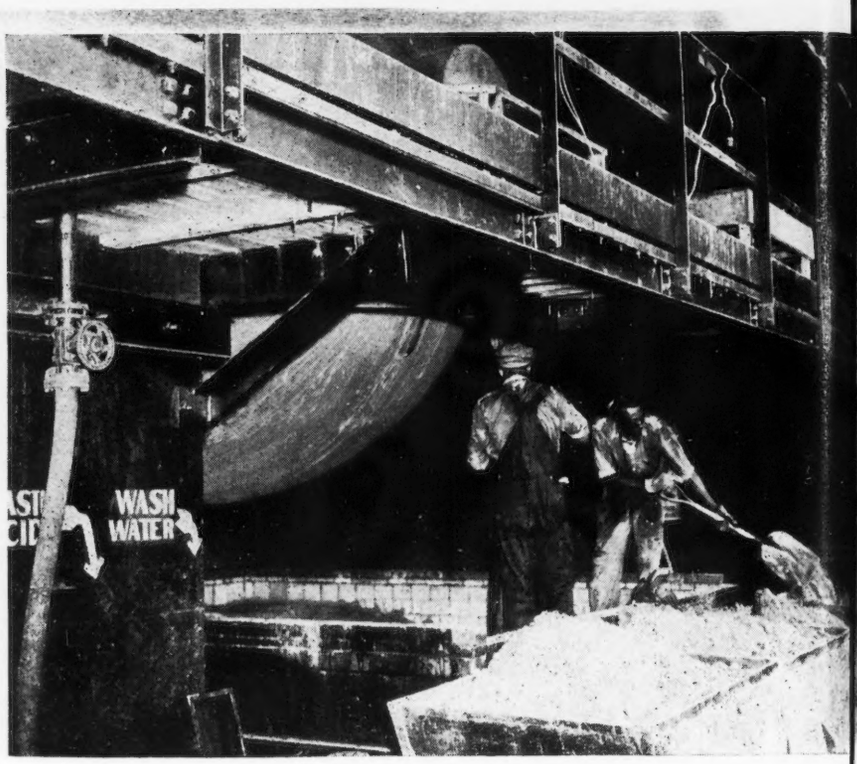
Concentrates enter the Longhorn smelter in railroad cars. As the 110-lb. sacks are unloaded from the cars, they are weighed, then either stored in piles or immediately opened and the concentrate crushed and sampled The bags are opened on a small platform over a short conveyor which moves the ore up into a small crushing and sampling mill. A small jaw crusher and a set of rolls break the ore down to minus $\frac{1}{4}$ in., and the crushed ore is then delivered to one of various stockpiles in small bins carried on Baker trucks or by portable conveyor belts. It is planned to install a conveyor system throughout the huge building in which the ore is stockpiled. More than 30,000 tons of ore can be piled in this building and all of it must be properly sampled, distributed, and labeled.

Three classes of ore are recognized at present. Class A ore contains 50 to 60 percent tin and is relatively low in antimony, iron, and silica. Class B ore has 40 to 50 percent tin and more impurities. Class C ore has 18 to 35 percent tin and is very high in silica, iron as limonite, and other impurities.

Treatment of the three classes of ore is as follows: A and B ores are roasted in rotary kilns under reducing conditions to reduce impurities to the soluble oxide form, and the calcines are leached in hot hydrochloric acid to remove iron, lead, copper, antimony, and arsenic as the chlorides. A small portion of these elements also goes off in the kiln gases. The leach residues then are smelted in two steps in reverberatory furnaces, and the tin formed is further purified in poling or drossing kettles. Class C ores are also roasted and leached, but because of the excessive amount of silica they contain, C leach residues are put through a gravity concentrator before they are sent to the reverberatories. This, in brief, is the sequence of operations; some of the detail involved in carrying out these steps will appear in the following discussion.

To begin with, each batch of ore presents a separate problem. After a consideration of the analysis of the head sample, the ore to be treated is trucked to one of a series of bins from which the rotary roasting kilns are fed. Others of these bins contain salt and petroleum coke, which are mixed with the ore in the proportions indicated by the head assay. Ores high in sulphur, for example, may require less coke than oxidized ores, and more salt may be needed for high-lead ores.

Seven rotary kilns, each 46 ft. long and 4 ft. inside diameter, are installed at present. Interior temperature is maintained at about 600 to 700 deg. C. by a natural-gas flame. To prevent reoxidation of the calcines they are discharged through a special water-



HYDROCHLORIC ACID LEACHING removes impurities from calcined tin concentrates preparatory to smelting. Leaching is done in spherical digester at left; residue is washed on Nutsch filter below

cooled cylinder and do not leave the kiln until they have been brought below 100 deg. C. in temperature. These kilns, together with the calcine cooling device, were designed by F. L. Smidth, of New York, and first tried out in Holland. Luckily, the drawings had been forwarded to New York just before the German invasion and were thus available for the Texas installation.

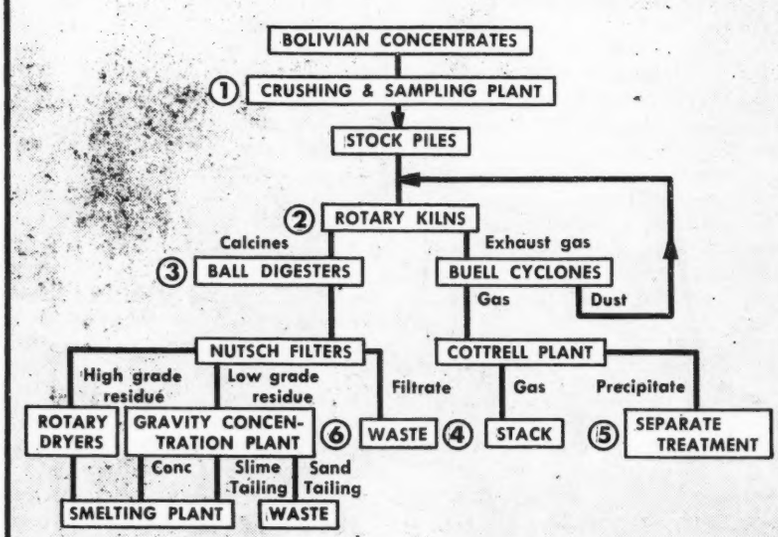
The ore is very dusty, and therefore the dust loss in the kilns is high. A Buell cyclone is connected to each kiln, and the collected dust is returned immediately by a screw conveyor. In this way the bulk of the dust is returned to the kiln where it originated, and mixing of different grades of dust is thus prevented. A Cottrell plant of 20,000-c.f.m. capacity collects the small amount of dust and fumes which escape the cyclones. These Cottrell precipitates are high in arsenic and antimony and are therefore reserved for special treatment with other high-antimony material in order to produce common tin.

Calcines are collected in bins and then charged in batches into one of several ball digesters. This is a weird-appearing apparatus consisting of a steel sphere, 10 ft. in inside diameter, mounted on hollow trunnions and lined with rubber and two layers of acid-proof brick. A door is provided for charging and discharging calcine and acid. About 10 tons each of calcine and 18 deg. Baumé hydrochloric acid, the quantity depending on the iron content of the calcine, are added to a digester, which is then rotated at 1 r.p.m. A 7.5 hp. gearmotor drives the sphere. During digestion, which usually takes from 6 to 8 hours, steam at 28-lb. pressure is injected through one of the trunnions and the interior temperature is thus raised to about 110 deg. C. Total acid consumption is about 100 tons per day.

Length of leaching period is based on experience, and when it is judged to be complete, the waste solution is discharged by decantation and the residue is dumped into a Nutsch filter which is built just under each digester. This filter is a 10-ft. square bed of filter tile and diatomaceous earth built on a checkerwork of acid-proof brick. A vacuum of about 20 in. of mercury is applied to the filter and the accumulated cake is washed several times. For the present the acid (less than 1 percent HCl) filtrate is being neutralized with lime and discarded, but preparations are being made to recover the several metals contained in this liquor. Tin, iron, arsenic, antimony, lead, copper, some silver and perhaps chlorine or hydrochloric acid itself, may eventually be recovered.

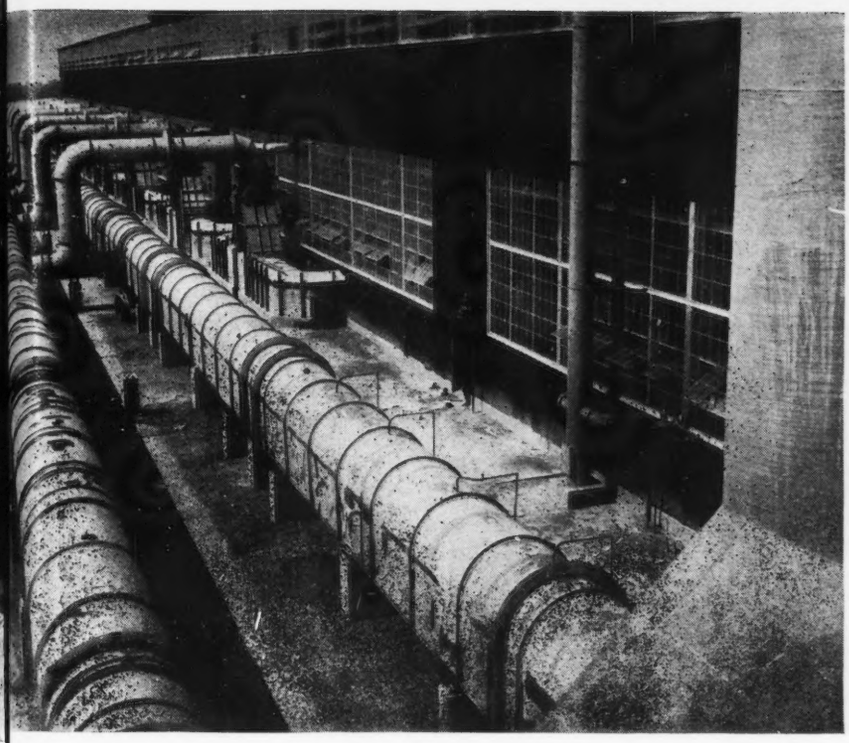
This leaching step is in one way the most important in the plant, because it is essentially the last opportunity to remove impurities other than iron. If the leaching has not been done well, and the residues are then allowed to enter the reverberatories, the tin made from this material will be perhaps too high in antimony and can be used only by mixing it with extremely pure tin or by purifying it by a lengthy and laborious agitation of the molten tin with aluminum, during which certain antimonides are formed which can

ORE PREPARATION — LONGHORN SMELTER



LEGEND

1. Through small crusher and rolls to minus ¼ in
2. Petroleum coke and salt added as needed.
3. Hydrochloric acid leach under steam pressure.
4. Solution will be treated in plant now under construction
5. These high-antimony precipitates go only to furnaces producing common tin
6. 2 Denver jigs and 28 Deister Diagonal-deck Tables.



EXHAUST FLUES shown here lead from the reverberatory furnaces to the Cottrell plant. One is in use while the other is being cleaned of accumulated dust which gases carry in extra-large quantities

be skimmed off. For this reason, it is sometimes necessary to re-roast and re-leach material which does not come up to specification on the first pass.

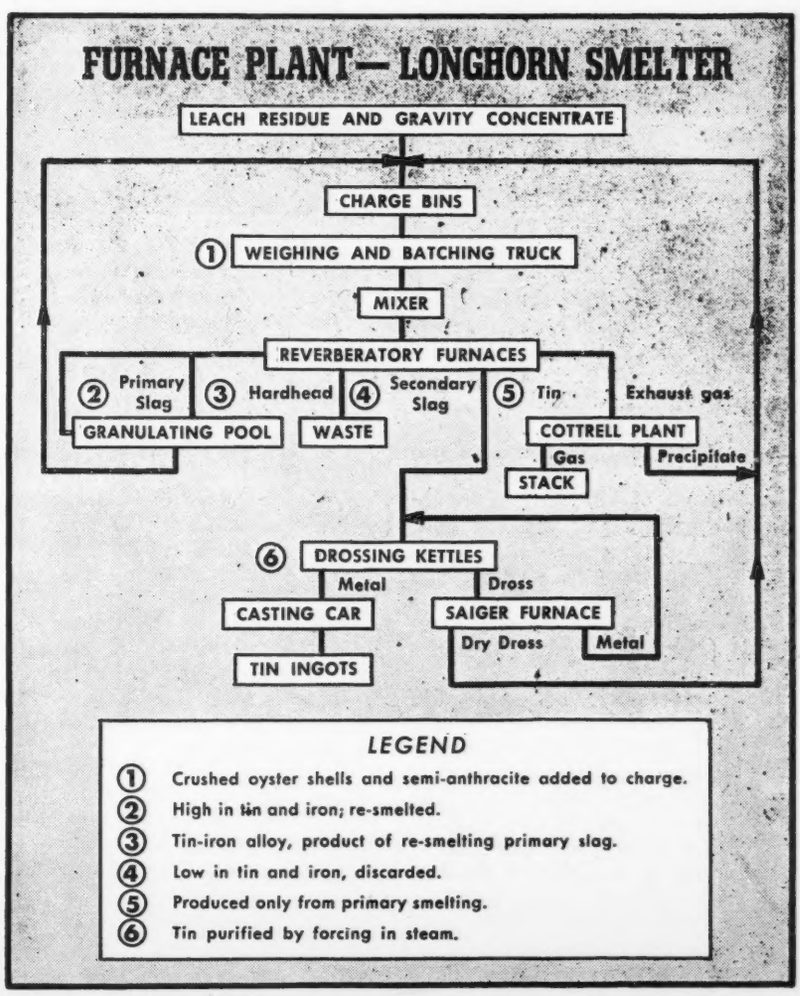
If the damp filter cake, which has been shoveled off the Nutsch filter beds, is to go to the furnaces, it is sent first through one of two small rotary dryers. This is done to prevent possible explosions in the reverberatories and to permit better mixing of the furnace charge. If, on the other hand, the residues consist of the lowest grade, high-silica material, they are sent to the gravity concentration plant.

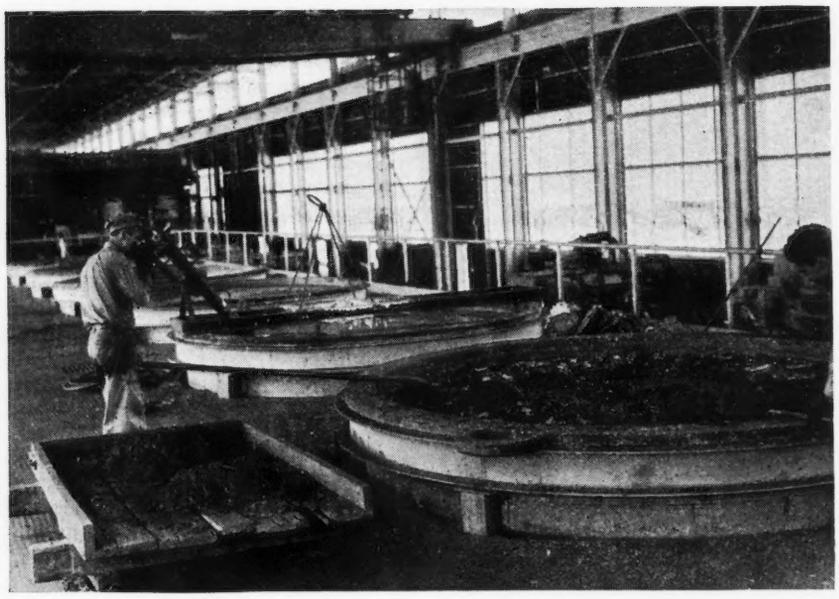
Capacity of the gravity plant is about 100 tons of leach residues per day. Attempts have been made to treat low-grade material directly in this plant, but it was found to be more profitable to roast and leach it first, because a much higher-grade concentrate can be made once the iron has been removed. In the gravity plant the residues are first deslimed at about 325 mesh, sands and slimes thereafter receiving separate treatment.

The flowsheet of the gravity plant is rather complicated and is varied constantly to meet new ore conditions. Briefly, it is as follows: Material coarser than 1 mm. is ground in a small rod mill, and the resultant minus 1-mm. sands are sized on screens and Fahrenwald classifiers. Coarsest size is treated by two 2-cell Denver jigs, and the finer sizes are passed over Deister Diagonal-Deck tables. The sand tailings generally carry less than 3 percent tin and are discarded. Middlings are recirculated over the tables. The minus-325-mesh slimes are also tabled, and though a good concentrate is produced, the tailings carry between 5 and 10 percent tin and cannot be discarded. They are mixed with a charge going to a secondary, or slag smelting, stage of the furnace operation, to be described later.

By means of this roasting, leaching, and gravity concentration treatment, a concentrate carrying 60 to 70 percent tin is produced. For example, low-grade material containing 24 percent tin, 20 percent iron as limonite, and 20 to 30 percent silica, will be concentrated by roasting and leaching to about 40 percent tin with only 4 percent iron. Gravity concentration then brings this grade up to 60 or 70 percent tin. Before this concentrate is sent to the furnaces, however, it is assayed, and if the impurities have also been concentrated to too great an extent, the material is put back through the roasting and leaching plant.

Primary feed to the reverberatory furnaces, therefore, consists of the residues of the roasting and leaching plant and the concentrates of the dressing plant. This material is smelted in two stages: In the first, only sufficient reducing agent is added to reduce most of the tin, leaving the iron and the remainder of the tin in the slag; in the second, the slag is re-smelted with more reducing agent in order to bring down a tin-iron alloy called "hardhead" and to form a slag low enough in tin to be discarded. The hardhead is granulated and returned to the primary smelting stage, where the tin is recovered and the iron acts as a re-





DROSSING KETTLES in which last of iron is removed from smelted tin. Note steam pipe placed in second kettle; steam bubbled through molten tin oxidizes iron and some tin to form dross

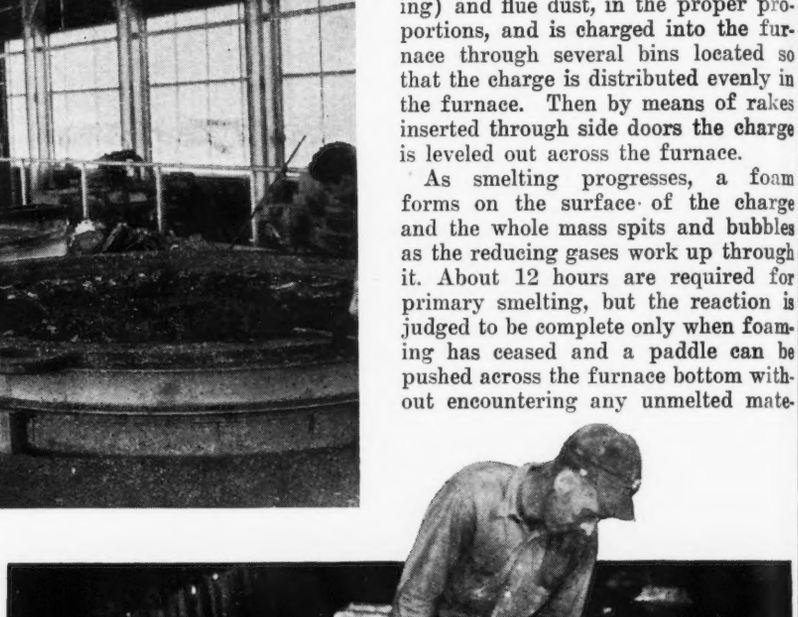
ducing agent on the original charge. Hardhead is roughly 80 percent tin and 20 percent iron, though these proportions vary considerably.

As the primary, ore-smelting, stage begins, the melt is basic, but as more tin is reduced, the slag gradually becomes acidic. The final slag to be discarded is a glassy, high-silicate degree slag. Because of this change in character of the slag, neutral refractories are used in constructing the reverberatories. Alumina is the chief constituent of the bricks used, but apparently brick density is of more importance than composition. The densest possible brick has been found to last longest, regardless of minor changes in composition. Refractories have been furnished by three companies: Harbison-Walker, A. P. Green, and General Refractories. About six months' service is obtained from each furnace, following which three weeks are required to tear the furnace down and rebuild it. Seven furnaces are in use at present, of which five or six are in actual operation at any one time. The practice is to operate a new furnace on primary ore smelting for about four months, then on secondary, or slag, smelting for two months, after which the furnace is generally ready for rebuilding.

The furnaces are of rectangular shape, the inside dimensions being about 12 ft. wide, 40 ft. long, and 3 ft. high. Depth provided for the pool of metal and slag is about 2 ft. The bottom is almost flat but slopes slightly toward a 3-in. drain hole located in the center of one side of the furnace. Natural-gas burners are placed in the center of each end and are flanked by two 2-ft. square openings, which serve alternately as hot-air inlets or exhaust-gas outlets. The furnace is fired from each end alternately, and the hot exhaust gases pass through a brick checker-work oven on their way to a Cottrell plant. When the oven is heated sufficiently, the flow is reversed, the other burner is used, and air is drawn in through the heated oven to be mixed with the natural-gas fuel. Temperature during primary smelting is maintained at about 2,300 deg. F., and secondary smelting is done at, about 2,800 deg.

Tin smelting is done in batches rather than continuously. Capacity of each reverberatory is about 30 tons, although the nature of the charge may require treatment in much smaller batches. The ore for primary smelting is mixed with lime, coke, granulated hardhead (from secondary smelting) and flue dust, in the proper proportions, and is charged into the furnace through several bins located so that the charge is distributed evenly in the furnace. Then by means of rakes inserted through side doors the charge is leveled out across the furnace.

As smelting progresses, a foam forms on the surface of the charge and the whole mass spits and bubbles as the reducing gases work up through it. About 12 hours are required for primary smelting, but the reaction is judged to be complete only when foaming has ceased and a paddle can be pushed across the furnace bottom without encountering any unmelted material. The entire charge is then drained from the furnace. Slag smelting is conducted similarly, but 16 to 18 hours are required to complete the reactions.



LONGHORN 3-STAR TIN meets all U. S. Treasury specifications and is fully the equal of finest Straits tin. Shown here is the mold bench on which the 80-lb. pigs are cast. Raised covers of molds are at left

As the charge drains from the furnace, it is caught in a forehearth, which greatly resembles an oversized bathtub. Made of steel and lined with firebrick, the forehearth can contain about 5 tons of molten metal, but its sole function is to separate slag and tin. Interior dimensions are about 8 ft. long, 2 ft. wide, and 3 ft. deep, and a partition is built across the center. As the charge drains into the forehearth, molten tin passes under the partition and eventually overflows at the left. The lighter slag floats on the tin and overflows at the slightly elevated lip at the right. Tin is caught in an 18-ton container called a float; slag is caught in ordinary slag

ladles. When the furnace is completely emptied, a crane picks up the forehearth and pours the remaining metal and slag into the float.

The crane then carries the float over to the refining floor, where its contents are dumped into one of the drossing kettles. The crane then returns for the slag ladles, which are emptied into a brick-lined launder, which discharges into a stream of water. This granulated slag is then picked up and stockpiled to await subsequent smelting. If, however, the source of the slag is a secondary smelt, the granulated slag is discarded.

Fumes from the furnaces pass through the heat-regenerating ovens referred to previously, and enter one of two long flues leading to a six-unit Cottrell plant. Dust deposits thickly in these flues; therefore one is in use while the other is being cleaned. Before reaching the Cottrell plant, which has a capacity of about 120,000 c.f.m., the gases have cooled to about 350 deg. F. Draft through the system is provided by large Clarage Fan Company fans located below the Cottrell precipitators. The precipitated dust is now returned to the smelter in small bins carried by the Baker trucks used throughout the plant for similar purposes, but preparations are being made to install a Fuller-Kinyon air pump which will return the dust through a 4-in. pipe.

The metallic tin produced in the primary stage contains the greater part of the impurities present in the charge other than iron. Lead, copper, antimony, and other impurities if present are reduced along with the tin, and, as mentioned previously, must therefore be eliminated before smelting is begun. Iron remains in the primary slag, which also contains 15 to 25 percent tin. Smelting this primary slag with coke and lime produces the hardhead, a tin-iron alloy, and a slag, containing about 1 percent tin, which is discarded. The hardhead is immediately poured into water to be granulated and is then returned to a primary smelting charge, where the tin is recovered and the iron acts as a reducing agent to bring down some of the tin in the original ore.

Nine drossing kettles are provided, each one holding about 50 tons of tin. They consist of ordinary cast-iron or steel pots set over furnaces of brick, in which natural gas is burned to provide a temperature of about 750 deg. F. in the molten tin. When a fresh charge is placed in a kettle, a pipe is run into the mass and steam bubbled up through it long enough to eliminate the last of the iron. The dross which accumulates on the surface of the tin is removed by skimming with a large perforated plate operated by the overhead crane. Some tin is carried along with the oxides. Therefore the accumulated dross is liquated in one of two small Saiger furnaces which out of a charge of about 10 tons of dross produce 2 tons of tin to be returned to the drossing kettles and 8 tons of dry dross to be added to a primary smelting charge.

When sampling and analysis show the tin to be acceptable, it is pumped out of the kettle into a casting car set on a track below the drossing-kettle floor. This car is moved along a row of molds of a length sufficient to allow removal of the cast bar in any one mold before the car has returned to it to cast a second bar. A circular casting machine resembling those used for copper is, however, under construction. A corner of each bar is sliced off for analysis, and the bars are weighed and stacked ready for shipment. Each bar weighs about 80 lb.

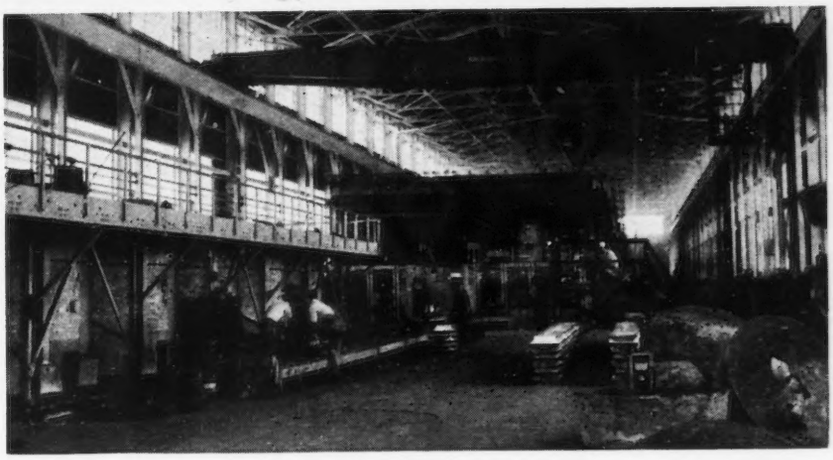
Two grades of tin are made at the Longhorn smelter. The three-star grade contains 99.8 per cent tin and meets all United States Treasury specifications; the two-star grade is common tin. Over 80 percent of current output is of the three-star grade. Users of both grades of tin have been well satisfied, and one tin-plate manufacturer reported better results than he had formerly obtained with Straits quality tin.

In considering the operation as a whole, three factors stand out as of prime importance; first, elimination of iron and other impurities by roasting and leaching; second, constant control to be sure of each step and to see that nothing is discarded until its tin content has been lowered to a set minimum; third, adequate, thorough dust and fume control to prevent tin losses in dust or by volatilization.

The importance of early iron elimination can be seen in considering the flowsheet, for it is evident that iron leaves the plant in large quantities only in the leach liquor, and if this is not done adequately, a large circulating load of iron would be built up. Other impurities must similarly be removed at this point. Fortunately, about 80 percent of the FeO formed in roasting is readily soluble in hot HCl, but, here again, the roast must produce FeO or the leach will fail.

Constant control samples must be taken at all times, so that the plant manager is never in doubt as to what to do with each product he has on his hands. In operating the plant, A. R. Merz, assistant general manager, has the responsibility for coordinating the several units and sees to it that each product is handled properly. Naturally, this requires an enormous amount of analytical work and a large, well-equipped laboratory works overtime to provide it.

To check plant performance, a balance is struck each month between tin known to have entered the plant in the ore and that which has left it in bars, slag, gravity tailings, leach liquors and dust. It is impossible to check oftener than this because of the large quantity of tin tied up in the plant in recirculating slag, hardhead, and dross, or in spillage, old bricks, or idle equipment.



FURNACE ROOM at Longhorn smelter contains reverberatory furnaces in background, drossing kettles on upper floor at left, mold bench at lower left, small Saiger furnaces for dross in center, and stacks of tin ingots at right. Large skulls at right are impure product awaiting re-smelting

Managerial personnel at the plant includes: J. van den Berg, general manager, who is also president of Tin Processing Corp.; A. R. Merz, assistant general manager; and V. J. Hampton, general superintendent. J. O. Ambler represents Metals Reserve Co. at the property. My thanks are due Mr. van den Berg for escorting me through the smelter and for his generous explanations of the processes involved.

BAGDAD—Arizona's L

BAGDAD COPPER'S mine and mill, in a remote part of Yavapai County, in western Arizona, at 3,500-ft. elevation. The headframe over the new three-compartment shaft rears itself above the crushing plant, in left center. The crushed ore is delivered via the upward-sloping covered conveyor gallery to the feed bins of the concentrator at the right

THANKS to the abnormal war-time demand for copper, and a government loan of $2,500,000, Bagdad Copper Corp. entered the ranks of active producers early in March, 1943, the entire project of shaft sinking and plant construction being completed in less than a year. With this initiation of large-scale operations, a period of exploratory work ended, involving both churn drilling and metallurgical test operations dating back more than 30 years.

At one time a 50-ton flotation mill was in operation for experimental ore treatment, the resultant concentrates being converted into a finished product in a leaching plant employing the Weatherbee process. Although satisfactory results were obtained, the high cost of a commercial plant, and the fact that subsequent improvements in flotation technique made economic treatment of sulphide ores practicable, caused abandonment of plans to erect this type of reduction works. Instead, the pilot mill was reconstructed and its capacity gradually increased to 300 tons. Operations continued on this basis until completion of the expansion program to be described.

Bagdad's property is in a remote section of Yavapai County, Ariz., at an elevation of about 3,500 ft. All materials and supplies needed for the different plant units and camp are trucked in from a distant station on the Santa Fe branch line serving the region. The total holdings, in which are included 74 patented claims, 70 unpatented claims, a townsite and a damsite, cover some 4,500 acres.

The expansion program just completed was financed by a $2,500,000 RFC loan authorized on Oct. 16, 1941. The entire project, involving construction of a 2,500-ton concentrator, sinking a new three-compartment shaft, providing a 7½-mile water supply line, a 23,500-ft tailings line, camp improvements, and numerous other tasks, was finished in less than one year.

Work on camp housing and other preparatory construction activities were started in February, 1942, and actual sinking operations at the new No. 3 shaft site were well under way at the end of March. In April, ground was broken for the new 2,500-ton concentrator, Southwestern Engineering Co., of Los Angeles, being responsible for its design, construction, and erection. Electric power from Parker Dam was available on Feb. 15, 1943, and the first concentrates were produced the first week of March.

The orebody under exploitation is in an island of quartz porphyry, locally called monzonite, which is roughly two miles long, east and west, and a mile wide, north and south, joining on the north the schist area containing the Hillside mine. On the remaining three sides is a granitic schist complex. The entire monzonite island carries some disseminated copper. The commercial portion lying therein was determined by a comprehensive diamond-drill campaign completed some years ago. It is roughly tabular in shape, somewhat like a book lying on end, and measures 1,400x800 ft. Minable thickness averages 125 ft. The theory of the mineralization is that there was a slump brecciation which thoroughly fractured the monzonite island and in turn made the rock physically amenable to the caving method practiced.

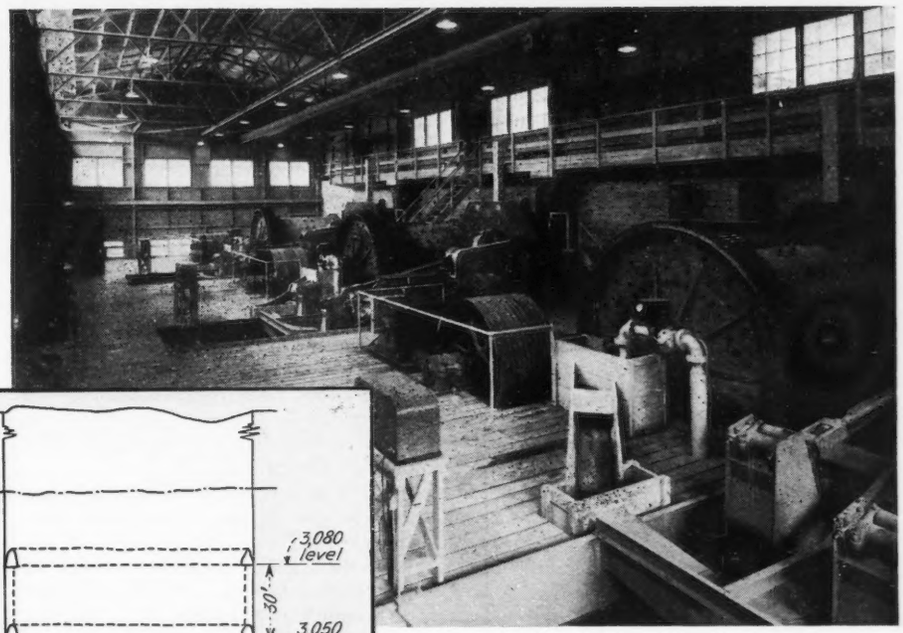
Chief point of difference between the Bagdad porphyry and other porphyry operations is the almost complete lack of rock alteration. This characteristic permits driving the greater part of extraction openings without timber, and also prevents crushing action on them in the stoping areas. The principal copper mineral is chalcocite. Considerable chalcopyrite occurs in the lower sections of the orebody.

Caving as currently practiced is explained in one of the illustrations. The ground is laid out to give blocks 100 ft. square, each containing about 100,000 tons of milling-grade material. The ore is undercut 30 ft. above the haulage level, and draw raises are spaced on 25-ft. centers. Each stope

Latest Porphyry Copper

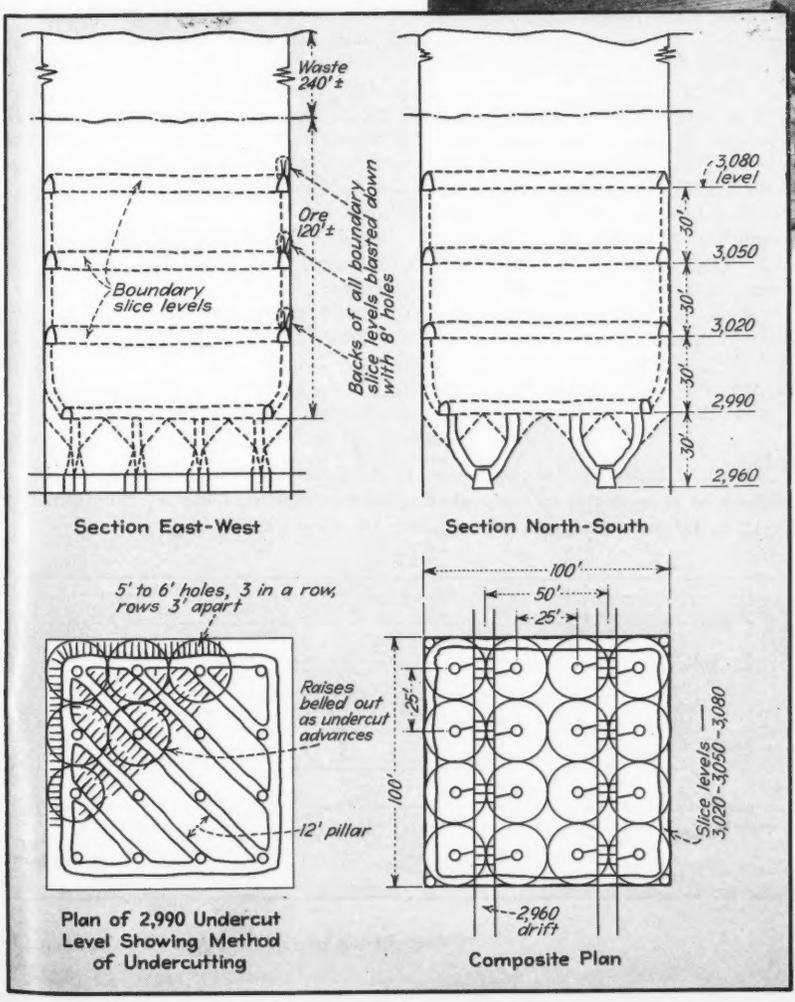
Under stimulus of war, this remote property gets into production in record time

J. B. Huttl *Assistant Editor*



GRINDING of the crushed minus-⅜-in. ore is done in these three No. 89 Marcy ball mills, each working in closed circuit with an 8x33-ft. Dorr FXX rake classifier. Each mill is driven by a 400-hp., 2,300-volt motor. Classifier overflow goes to flotation

BLOCK CAVING, as practiced by Bagdad Copper, is illustrated for a block 100x100 ft. in dimensions and containing 100,000 tons by these vertical sections and plans. Draw points are spaced on 25-ft. centers



is served by two haulage lines on 50-ft. centers, with 16 draw raises, or eight per line. The four walls are weakened by three boundary slice levels at 30-ft. vertical intervals, the drifts being driven around the four sides, and their backs blasted down an additional 8 ft. The drifting plus the blasting down of the back constitute in effect a semi-shrinkage stope which creates a plane of weakness around all four sides of the block, thus accelerating caving somewhat and at the same time holding the caving within definite limits.

On the undercut level, drifts are driven diagonally across the tops of the draw raises so as to leave a pillar 12 ft. wide. These are easily blasted out with side holes 5 to 6 ft. deep drilled in the drift. As the undercut is blasted down, the vertical sections of the draw raises are belled out.

Actual drawing of ore is done

through chutes spaced at 25-ft. intervals in the haulage lines or drifts. Each chute is equipped with a hand-operated, heavy steel arc gate with a 20x30-in. opening. Occasionally some chute blasting is necessary, which is generally done in the bottom part of the belled-out section of the raise. Because of the fractured nature of the rock, chute blasting is no problem.

Haulage drifts are driven 8x8 ft. in cross-section. Drifts in the upper levels are driven at 5x7 ft. Practically all draw raises, corner raises, and other vertical openings are untimbered and 4x4 ft. in size. Drilling in the drifts is done with jackhammers. In the raises light, self-rotating stopers are used. The drills are of Ingersoll-Rand and Gardner-Denver make. All use steel fitted with Jackbits. On the upper levels I-R slushers with scrapers are used in drifting, it being possible to serve three headings from one set-up of the hoist. Eimco loaders muck broken ore into 2-ton gable-bottom Card Iron Works cars on the haulage levels. Haulage equipment consists of two 3-ton Goodman electric battery locomotives and three 1½-ton Mancha units. The latter are used for gathering only and never leave the stoping area, whereas the larger units haul made-up ore trains to the shaft loading station 1,200 ft. distant.

DuPont 40 percent Gelex dynamite is used for blasting, the charges being detonated electrically. In chute blasting, the bomb is placed in position by means of 1x1-in. blasting sticks, with the operator always working from the drift. The bomb is exploded by electric caps. Owing to the fractured nature of the monzonite, development cost is relatively low. For instance, a 5x7-ft. drift can be broken to a depth of 4 ft. with 9 to 11 holes and 40 to 50 sticks of powder.

Standing at the head of the crushing plant is the headframe of the new No. 3 shaft. The shaft is 465 ft. deep. It has two hoisting compartments that measure 6x7 ft. inside the timbers, and a manway 5x7 ft. The level serving the upper workings is at 220 ft., and the main haulage level at 340 ft. The skip-loading station, which has air-operated doors, and the pump station, are at 400 ft. and 440 ft. respectively. Just below the 340-ft. shaft station is a 500-ton concrete storage pocket covered with steel rails spaced 12 in. A battery charging room is maintained a short distance from the shaft station. Underground pumping equipment consists of two I-R centrifugal pumps, each capable of handling all the water made, the amount varying from 50 to 90 g.p.m. with the seasons.

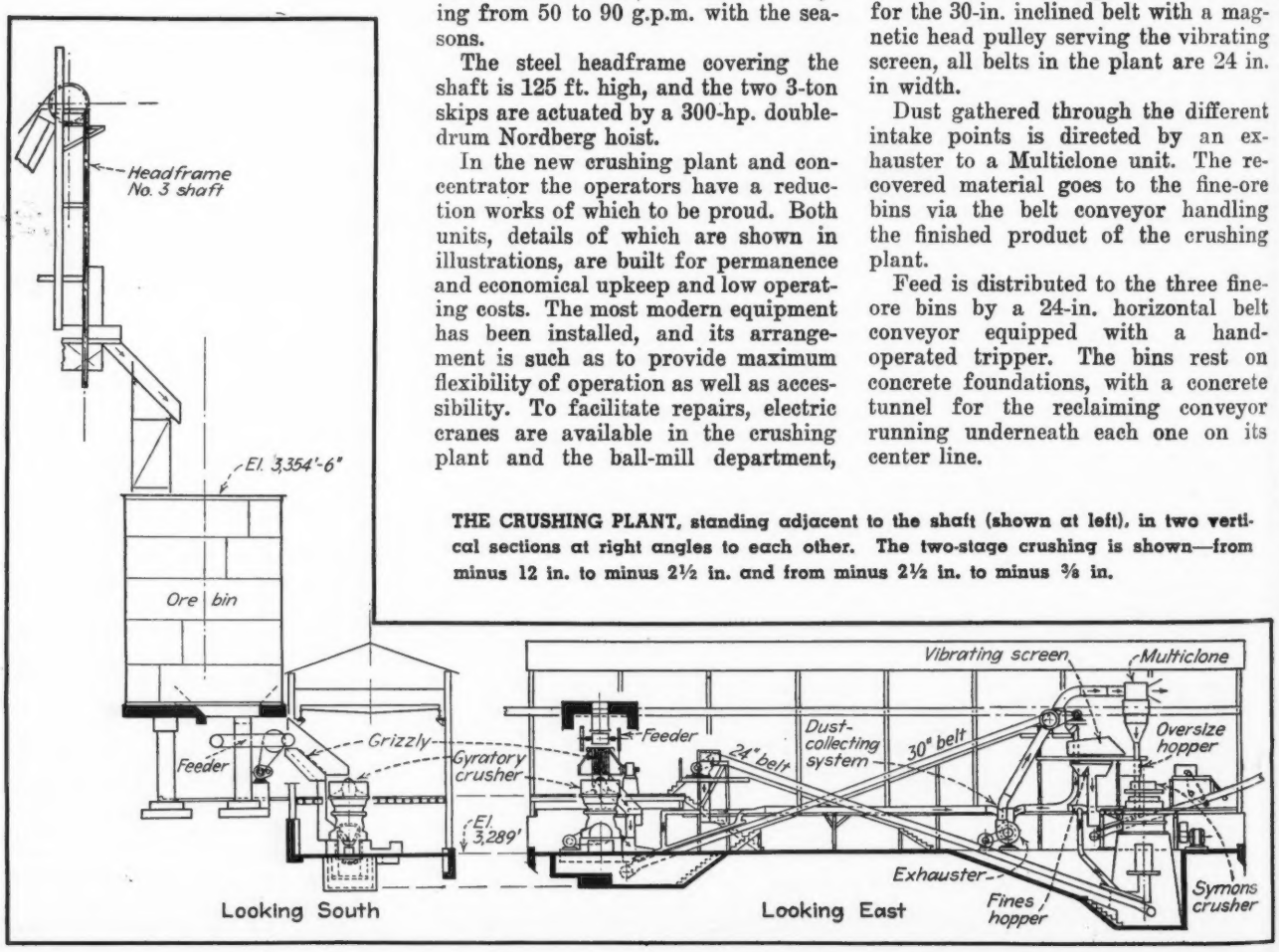
The steel headframe covering the shaft is 125 ft. high, and the two 3-ton skips are actuated by a 300-hp. double-drum Nordberg hoist.

In the new crushing plant and concentrator the operators have a reduction works of which to be proud. Both units, details of which are shown in illustrations, are built for permanence and economical upkeep and low operating costs. The most modern equipment has been installed, and its arrangement is such as to provide maximum flexibility of operation as well as accessibility. To facilitate repairs, electric cranes are available in the crushing plant and the ball-mill department, and there is a separate crawl above each bank of both the copper and the molybdenum flotation cells. All buildings are fireproof, being built of steel frames covered with corrugated iron sheets. Large windows provide adequate light and ventilation. This, together with numerous safety features in the various departments, makes for safe working conditions. The crushing plant is equipped with a modern dust-collecting system.

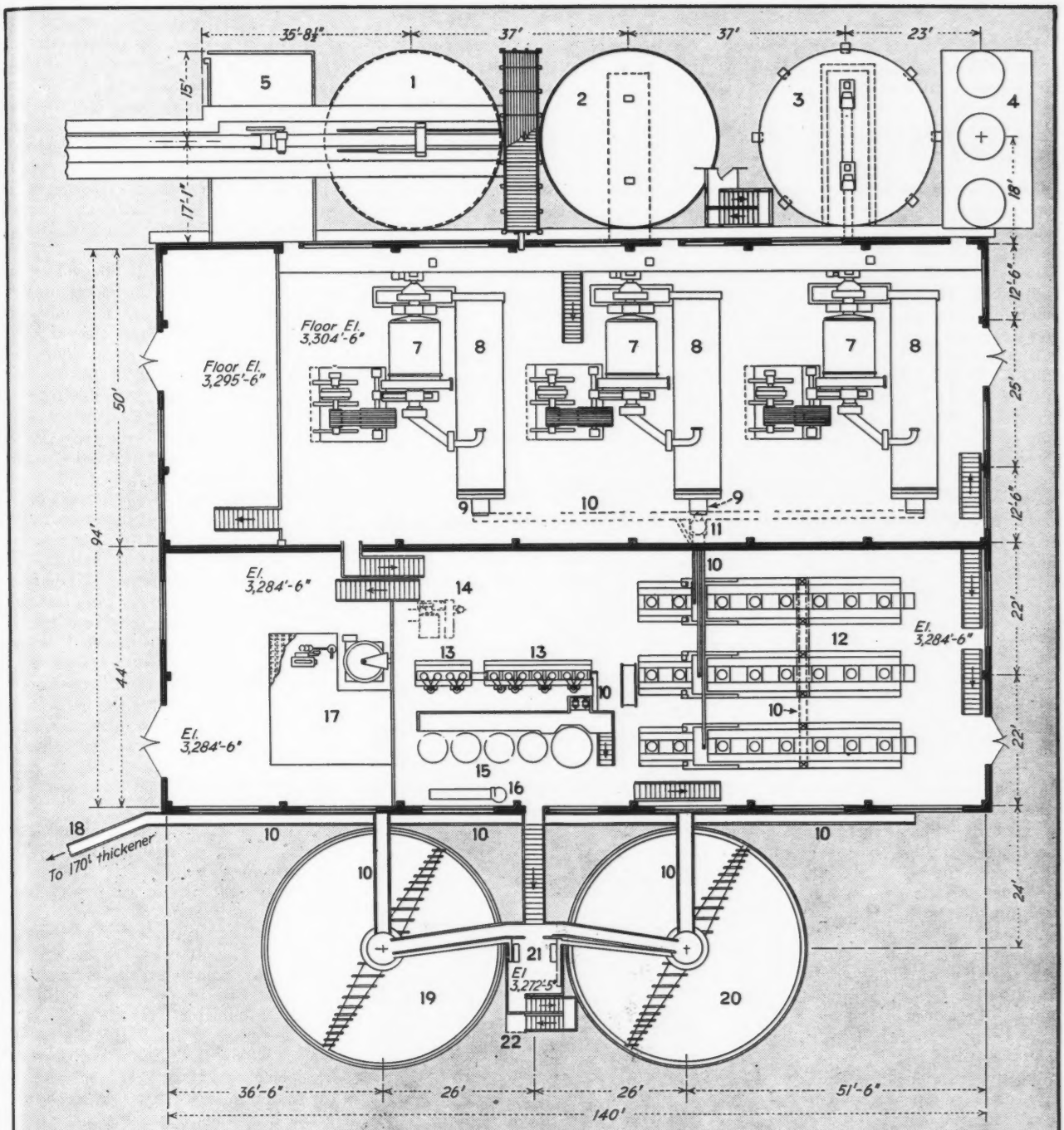
Crushing plant capacity is calculated at 170 tons per hour. Mine-run ore, of 12-in. maximum size, is hoisted in 3-ton skips and dumped into a 1,000-ton storage bin at the head of the plant. Reductions to mill feed size is done in two stages. From the primary bin the ore is drawn through a hopper directly above a manganese-steel pan feeder discharging onto a steel grizzly, with bars spaced 3 in. apart. Oversize goes to a 16-in. McCully gyratory crusher set to 2½-in. The product, with the grizzly undersize, is conveyed by belt to a 5x8-ft. Symons rod-deck screen which works in closed circuit with a 5½-ft. Symons short-head cone crusher. The minus-⅜-in. undersize is the mill feed. This mill feed is conveyed to three 1,000-ton circular steel bins at the head of the concentrator by an inclined conveyor belt equipped with a Merrick weightometer. Save for the 30-in. inclined belt with a magnetic head pulley serving the vibrating screen, all belts in the plant are 24 in. in width.

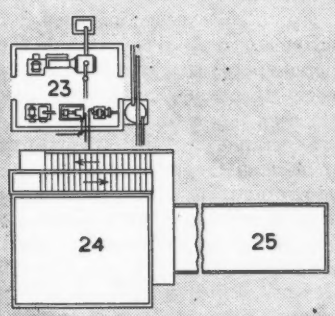
Dust gathered through the different intake points is directed by an exhauster to a Multiclone unit. The recovered material goes to the fine-ore bins via the belt conveyor handling the finished product of the crushing plant.

Feed is distributed to the three fine-ore bins by a 24-in. horizontal belt conveyor equipped with a hand-operated tripper. The bins rest on concrete foundations, with a concrete tunnel for the reclaiming conveyor running underneath each one on its center line.



THE CRUSHING PLANT, standing adjacent to the shaft (shown at left), in two vertical sections at right angles to each other. The two-stage crushing is shown—from minus 12 in. to minus 2½ in. and from minus 2½ in. to minus ⅜ in.





LEGEND FOR CONCENTRATOR LAYOUT

1. No. 1 fine-ore bin, 30 ft. in diameter, showing conveyor and tripper over it; also conveyor under it
2. No. 2 30-ft. diameter fine-ore bin, showing tunnel and conveyor under it
3. No. 3 30-ft. diameter fine-ore bin, with conveyor and tunnel under it
4. Reagent storage house, with three 8-ft. diameter tanks
5. Lime house
6. Grinding-mill ball-storage bin
7. and 8. No. 89 Marcy ball mill
9. Density control box
10. Launder
11. Siphon distributor
12. Copper flotation machines
13. Molybdenum flotation machines
14. 3x3-ft. ball mill and classifier
15. Conditioners, one 5x9 ft.; three 5x5 ft.; and one 7x7 ft.
16. Southwestern dry reagent feeder and 30-in. mixing tank
17. Molybdenum filter and dryer. Sacking house (in broken lines)
18. Launder running to 170-ft. thickener
19. No. 1 40-ft. thickener
20. No. 2 40-ft. thickener
21. 2-in. Dorrco pump and two 1½-in. Allen-Sherman-Hoff pumps
22. Pump house
23. Pump house for filter plant, contains vacuum pump and blower
24. Filter house (over) and copper concentrate loading bin (under)
25. 30-ton scales

Lime and reagent storage facilities are provided at the end of bins 1 and 3 respectively. Grinding balls are stored in a wooden bin between bins 1 and 2, and are distributed to the ball mills by an ingenious ladder system.

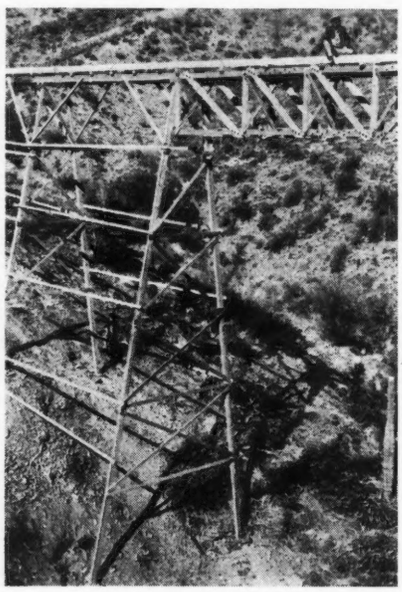
At the bottom of each bin are two oblong openings fitted with Hardinge constant-weight feeders, which discharge the withdrawn ore into a steel hopper installed above a 24-in. inclined belt conveyor leading to the feed box of the ball mill. Single-stage grinding is practiced. Grinding equipment consists of three No. 89 Marcy ball mills, each in closed circuit with a 8x33-ft. Dorr DFX classifier equipped with a Massco density control unit. The mills are driven by 400-hp., 2,300-volt synchronous motors. Ball charge consists of 2- and 3-in. steel balls. As to the fineness of grinding, pilot-plant operations indicate that maximum recovery can be obtained by grinding to 4 to 5 percent minus 65 mesh, and holding flotation density at 27 percent solids. These figures, it is believed, will hold good with the units now in operation. Classifiers are 3 ft. over the calculated length necessary for proper classification in the ball-mill circuit. This extra length has been provided to permit installation of unit cells on the ball-mill discharge if that is found desirable.

Classifier overflow goes to a 10-in., three-compartment, Southwestern siphon distributor serving three banks of six-cell, 66-in. Fagergren flotation machines. Cleaner equipment consists of two-cell, 56-in. Fagergren flotation machines installed at the feed end of each rougher unit. Bank 1 of rougher cells can be operated separately in connection with ball mill 1 as an experimental unit. The sand pump installation has been arranged accordingly. Two 3-in. Hydroseal pumps (one being a spare) deliver the concentrates produced by bank 1 to the respective cleaner unit, and two 4-in. Hydroseal pumps serve banks 2 and 3 in a like manner. Rougher tailings flow by gravity to a 170-ft. Dorr torque thickener, and cleaner tailings return to the heads of the rougher machines. Finished concentrates go to a 40x10-ft. Dorr thickener with a 2-in. duplex diaphragm pump.

Surmise that the copper concentrates contain some molybdenite sulphides prompted the decision to install an experimental section to determine this point. If it be correct, this mineral can then be recovered. The planned procedure for which equipment has been provided in the molybdenite recovery plant calls for treatment in three Southwestern steam digesters (one 5x9 ft. and two 5x5 ft.); two cooler conditioners measuring 5x5 ft. and 7x7 ft. respectively; a Denver flotation machine composed of seven No. 15 cells installed for countercurrent pulp and froth operation; a No. 12 Denver four-cell flotation unit so arranged that the froth from any cell or group of cells can be sent to any succeeding cell or group of cells, and the tailing from any cell or group of cells can go to the next succeeding cell or back to the head of the molybdenite section; and auxiliary units.

Concentrates from the seven-cell rougher machine would be reground in a 3x3-ft. Denver ball mill with a 2x8-ft. Akins classifier before treatment in the cleaner machine. Rougher tailings or final copper concentrates would flow to a second 40x10-ft. Dorr thickener equipped with a 2-in. duplex Dorr diaphragm pump, and the cleaner tailings would return to the first thickener mentioned previously or to the head of the molybdenite circuit. Finished molybdenite concentrates would be treated successively in a 7-ft. dewatering cone, 4-ft. one-leaf Eimco disk filter, and a steam-jacketed pug-mill dryer. Filtrate would return to the dewatering cone.

Steam for the three magnesium-block insulated digesters would be furnished by a 25-hp. oil-fired boiler.



AN ENGINEERING FEAT was the construction of the 23,500-ft. long tailings line. The tailings are sent to waste at 50 percent solids, flowing through Transite pipe of 7-in. inside diameter, here supported on a wooden trestle

Final copper concentrates are pumped to a 6-ft., six-leaf Eimco disk filter for additional dewatering, the filtrate returning to thickener 2. Finished concentrates are trucked to the railroad loading station about 26 miles distant for shipment to reduction works.

Reagents used in the copper section include lime for proper alkalinity, xanthate as collector, and pine oil as frother. Laboratory tests indicate improved recovery by the use of sodium sulphide. This will soon be tried out on the experimental section or rougher bank 1. Dry reagents are fed with Southwestern belt feeders. Liquid feeders of the same make are used for handling liquid reagents.

Sampling is done with 30- and 16-in. Southwestern straight-line samplers at the feed end of each ball mill, on the rougher tailings and cleaner concentrates in the copper section, and on the rougher tailings and cleaner concentrates in the molybdenite section.

Water reclaimed by the 170-ft. torque thickener is returned to the mill-water supply tank. To this tank is connected the fresh water tank, from which the flow of make-up water is controlled by a float valve arrangement actuated by the rise and fall of the mill-tank water level. Underflow from the torque thickener goes through two 5-in. pipes in a concrete tunnel to a turn box outside the tank structure. The pipes are fitted with cock valves near the tunnel face, and on both sides of each valve are high-pressure water connections to remove any stoppages. Nordstrom valves and adjustable orifices for quick density control are installed at the discharge ends of the pipes.

Construction of the tailings line was a major engineering feat. The line traverses exceptionally rough terrain in several places, which involved construction of numerous wooden trestles and other supports. Total length is 23,500 ft. It was erected under contract by Southwestern Engineering Co. The line proper is made of 7-in. inside-diameter Transite pipe laid on a grade of $\frac{1}{4}$ in. to 1 ft. At 50 percent solids, the tailings will flow at a velocity of about 5 ft. per second. To facilitate discovery of stoppages in the line, and relieve them, junction boxes have been placed at 1,000-ft. intervals. Each box has a screened overflow outlet at the top. At one point, where the line crosses a canyon, a siphon has been installed. Distribution to desired points at the tailings-disposal site is effected by a network of branch lines, and provision has been made for reclaiming water.

Severance A. Millikin is president of Bagdad Copper Corp., C. Q. Schlereth, operating vice president; J. W. Still, general manager; Elmer Tomkinson, mine superintendent; and J. C. McIntosh, mill superintendent. To Messrs. Schlereth and Still grateful acknowledgment is made for the many courtesies and hospitality shown me during my recent visit to the property, and for the data presented here.

"RFC Must Follow the Law" —in Loans to Mining Companies

Although its policies and procedures have been liberalized by Congress, its powers are limited and it cannot make gifts

Charles B. Henderson
Chairman of the Board
Reconstruction Finance Corporation
Washington, D. C.

MY PURPOSE in writing this article is to outline the policies and procedures of the Reconstruction Finance Corporation with reference to mining loans from the time of the first grant of authority, a decade ago, up to and including the present war period.

The RFC was established pursuant to an Act of Congress approved Jan. 22, 1932. The creating Act stated generally that in order "To aid in financing agriculture, commerce, and industry . . . the Corporation is authorized and empowered to make loans . . . ." There followed the types of institutions to which loans could be made and the requirement that "All loans made under the foregoing provisions shall be fully and adequately secured."

The Corporation has only the authority and powers conferred upon it by the Congress. Congress fixes the limits and the Directors of the Corporation are bound thereby.

The foregoing provisions, moreover, make it clear that the Corporation was not intended to be an eleemosynary institution. It was not empowered to make gifts. The RFC Act and its amendments have been remedial legislation. The basic principle of remedial legislation is to enable people to help themselves. The purpose of RFC legislation has not been to displace private enterprise, but to supplement such enterprise by aiding in financing agriculture, commerce, and industry. These broad terms were sufficient to include the mining industry, but the help for a time was indirect in that the then law required that it be furnished through the medium of loans to financial institutions.

The Congress soon gave added recognition of the importance of the mining industry, if the national economic structure were to be made sound, by providing more direct aid to the industry. By an amendment approved June 19, 1934, the RFC was authorized and empowered "to make loans upon adequate security based on mineral acreage to recognized and established incorporated agencies, individuals and partnerships engaged in the business of mining, milling and smelting of ores."

Some six months later, on Jan. 31, 1935, the RFC's power with respect to mining aid was further increased by amending the foregoing provision to authorize loans to corporations and other entities "engaged in the development of a quartz ledge, or vein, or other orebody, or placer deposit, containing gold, silver or tin, or gold and silver, when, in the opinion of the Reconstruction Finance Corporation, there is sufficient reason to believe that, through the use of such loan . . . there will be developed a sufficient quantity of ore, or placer deposits of a sufficient value to pay a profit upon mining operations." The sum of $10,000,000 was allocated by Congress for such development loans, but no single entity could receive a loan in excess of $20,000, to the end that a large number of applicants could receive aid from the total sum provided.

Important as was the authority to make development loans, the most notable aspect of the 1935 amendment was the change which permitted the loans to be made to established enterprises, upon "sufficient security" instead of "adequate security." This liberalization conferred more discretion upon the Directors and enabled them to extend the benefits of the law to a greater number than ever before of those in the mining industry who needed financial aid.

RFC Must Steer Safe Course

It is well to remember that the Mother Lode of California and the Comstock Lode of Nevada helped build the Empire of the West. It is also well to remember that within the

mining fraternity dwell the fabulous dreams of the "Seven Cities of Cibola." Between hard facts and miners' dreams the RFC was directed by Congress to steer a safe course.

In keeping with the trust imposed and the spirit of the then law, it was necessary for the RFC to require a mortgage as security. This was a condition common to any business where money was advanced. The Corporation also exercised supervisory power over the disbursement of the loan, for it was the money of the Government, and thus of the people, and by law the Corporation was held to strict accounting by the Congress. The requirement that the capital stock of incorporated mines should be pledged to the RFC was imposed for the sound and salutary reason that there could not then be speculating in the Mining Exchanges on Government credit. Such requirements may have been often decried as "red tape," but they were limitations and safeguards, specifically set forth or clearly implied, which Congress in its collective wisdom saw fit to impose. It was because of this clear intent that the RFC did not loan money for prospecting, in the sense of "grubstaking." It loaned money only for the development of a known vein or other deposit containing gold, silver, or tin. This was the situation until the National Defense period.

In 1940, the year the National Defense Program was enlarged, the authority theretofore granted was supplemented by providing that the RFC be empowered to make loans to develop "any strategic or critical mineral which, in the opinion of the Reconstruction Finance Corporation, would be of value to the United States in time of war." The Section was also amended so as to increase the aggregate amount which could be loaned to any corporation, individual, or partnership to $40,000—double the former limit.

At this same time, June of 1940, there came into the RFC Act as Section 5d(1), the authority for the RFC to finance corporations for the production, acquisition, and stockpiling of strategic or critical materials and for plant construction, expansion and equipment, and working capital to be used for the purpose of National Defense. While this June 1940 Amendment was general in terms, it was not until the enactment of the specific, further amendment in June 1942—referred to below—that RFC considered that it was authorized to apply the June 1940 Amendment to mining loans, except to corporations and as directed or requested by authorities particularly charged with the National Defense.

There were, then, in the years from 1935 through 1941, two types of loans authorized by Congress—a general mining loan, and a development loan in an amount not to exceed $40,000. The difference between these loans was that a general mining loan was granted only to recognized and established enterprises already engaged in mining, while the development loans were made to small mine owners engaged in the development of ledges or veins where there was some showing that working might be profitable. During their investigations the RFC engineers had to keep constantly in mind the three requisite sufficiencies—namely, sufficient reason, sufficient quantity, and sufficient value.

Security Must Be Considered

The administration of the RFC's mining loan authority during this period was criticised by many of the mine developers of the West. Everyone who has lived in a mining country knows the optimism of the prospector who has discovered an outcrop. However, everyone who has had experience with mining engineers knows their satisfaction in finding a real mine. The engineers of the RFC have had no desire to burden or impede mining or development operations, but the guiding standards which Congress had set in the law necessarily have sometimes made final action less favorable or prompt than many desired. It was a concrete condition and not an intangible principle which confronted the engineers. There were always the matters of security, the three sufficiencies, and the eventual accounting to Congress, to be considered. These were admittedly actual and psychological barriers to free and hasty action or decision, but Congress itself had imposed the conditions.

Then came the war, and the need for strategic and critical metals became acute. On March 27, 1942, the Board of Directors of the RFC announced that the owners or lessees of mining property might secure a loan from the RFC repayable out of proceeds from production rather than a mortgage on the mining property. These mining development loans were to be made initially in amounts not in excess of $20,000. If the results were favorable, additional loans up to $20,000 might be made for further development. This announcement was designed to speed up development of small ore deposits containing strategic and critical metals and minerals.

Lawyers of the Mining Section had been working some time on simplifying the legal requirements to the maximum extent possible, while at the same time maintaining adequate safeguards. They evolved an Instrument of Security and Chattel Mortgage, which was a lien on the proceeds of the mine and a mortgage on any equipment purchased with the loan funds; a deposit agreement, which gave the engineers supervision over the disbursement of the loan funds, and a promissory note to be payable out of proceeds.

The foregoing was designed to obtain what security was available, but in substance it was a chance the Corporation took with the miner on the ore content of his vein or placer deposit. For each loan the RFC makes, under any of its powers, there must be security, a lien, and a promise to repay. These are statutory requirements. Under the particular hazards of mining there must also be supervision to see that the money is properly expended for the production of strategic metals. Any miner who has faith in his mine will not refuse to sign these simple documents, or allow such supervision, regardless of the sincerity of his belief that they may be so much "red tape." No bank in the country would advance one cent on any such terms.

Engineers Speed Examinations

RFC engineers were directed to speed up their examinations. Despite comment to the contrary, it has not been RFC practice to decline marginal mining loans. Those which were obviously worthless were declined, for there remained ever present the specific statutory condition that there must be a sufficient showing that the ore was of sufficient value to expect a profit. It was this requirement in the law which made it impossible, for a time, to loan money for dewatering, retimbering, or for accessibility or preliminary development of mine workings.

Upon the suggestion of a large number of Senators of the Western States, the RFC agreed with the principle of authorizing loans, not to exceed $5,000 to any one borrower, for the purpose of making old bodies of ore accessible, so they could be assayed or sampled to determine whether the mineral showings were sufficient to warrant development loans. If the use of the $5,000 or any part of it disclosed promising ore, application could then be made for a development loan.

The foregoing policy was officially approved and an indefinitely greater latitude was given by the Amendment of June 1942, whereby the Corporation was authorized to make loans for "any purpose deemed by the Corporation to be advantageous to the national defense."

Since June, 1942, all loans are made under the provisions of this new Section. The only condition for a loan is a showing of ore of value to the National Defense. Under this policy the requirements of the $5,000 loans were liberalized, and con-

sisted merely of a resolution and an agreement with the borrower. The agreement is sent to the Supervising Engineer in the field, who obtains the signature of the borrower and then obtains the money from the Federal Reserve Bank, which is thereupon deposited in a bank selected by the borrower.

On loans up to $30,000, more is required, since the borrower must execute a document which can be recorded. But even in these cases there are only three documents, the security instrument, the promissory note, and the deposit agreement which appoints a bank and directs how the borrower may withdraw the loan funds.

Legal Procedure Simplified

The legal procedure of passing on title to properties has been greatly simplified and the legal policies liberalized so that there is no legal delay in disbursing a loan. The borrower is still required to provide an abstract or a legal opinion as to the validity of his title, but this is used merely for a check-up after the loan has been disbursed. It would be impossible, even in war time, to cut these requirements more and still insure the protection of government money prescribed by the Congress.

In 1942 the RFC initiated, in connection with these preliminary development loans, a program especially designed to aid the small mine owners. In the consideration of loan applications, the RFC obtained the help of mining schools of the West and the State Mining Bureaus serving in an advisory capacity. Their conclusions are sent to the Supervising Engineers of the RFC who review them and then forward them to Washington, where they serve as a guide in the final consideration of the loan application. The country is pretty thoroughly combed in this way. Meetings have been held in many mining states. The miners' complaints and suggestions have been listened to and carefully considered. Where indicated, procedure has been modified or amended accordingly.

The engineers in the Mining Section in Washington are graduate engineers. Most of them have had experience in the mining districts of the United States and other parts of the world. They have been connected with important projects. They belong to the mining fraternity and have the miner's viewpoint, but they have much to do and their problems, too, are important and difficult. The Supervising Engineers in the field have the same background as those in Washington. They know the mining country thoroughly from prospect hole to great producer. Not all the great mines in this country yield gold and silver, for great wealth has been produced in this country from mines giving up other than those precious metals.

The Mining Section has a number of lawyers who are men of experience in mining, business, and administrative law. They are concerned with simplifying procedure and devising means for the most expeditious handling of mining loans. They are easily accessible to all borrowers and their offices are always open to applicants for advice and assistance.

Complaints Investigated

All complaints received from whatever sources in the field are thoroughly thrashed out by the staff in Washington, and full attention is given to them whether they are presented by the applicant himself in letter or in person, or by RFC field representative.

Many of these difficulties, which we shall always in some measure have with us, arise by reason of the fact that a miner thinks his prospect is a mine and the engineers, though trying to be helpful, are compelled to disagree. This is the history of mining. One of the larger copper mines was unearthed, so it is said, by the squeal of a pig which led to the discovery. A mule kicking into view the outcropping of a lode, or a tree uprooted has revealed precious metals. But the Corporation must still depend on more provable and less fortuitous facts.

One complaint concerns the lag between an accessibility loan and a development loan. This has been investigated. When a borrower notifies our representative that the mine has been made accessible, the representative then goes to the mine, examines it, gets samples and has them assayed. Our information is that the assay offices are very busy and it is often a number of days before the assay report is available for consideration.

As soon as assay reports are made available, the representative makes his own report and, if favorable, the Mining Section makes a recommendation to the Board, which acts immediately. The Board of the RFC meets every day and the RFC is open for business every day, including holidays.

What has been accomplished? That can be answered by the impartial statement of Howard I. Young, Director of the Mineral Resources Division of War Production Board, testifying before the Metals and Minerals Sub-Committee of the Senate Small Business Committee:

"Inasmuch as your committee is vitally interested in assisting the small operators to produce needed metals and minerals, I thought you would be interested in knowing what has been done in this respect in 1942 and the first two months of 1943 by the Reconstruction Finance Corporation.

"Total commitments during the past 14 months to all small operators amounted to approximately $4,000,000 to assist in mineral and metal development, this sum going to 448 different projects. 258 of these 448 loans averaged $3,943 each and applied to projects involving 10 different strategic metals and minerals in 18 different states and totalled over $1,000,000. 190 of the 448 commitments were to mine operators in 24 different states and Alaska in connection with projects to produce 18 different strategic metals and minerals. The average of these loans was $15,360 and their total amounted to $3,000,000."

The functions which the RFC itself directly performs must be distinguished from those it performs indirectly through Metals Reserve Co. and Defense Plant Corporation. The function of the RFC is to make direct loans; the function of Metals Reserve Co. is to purchase and acquire or deal in strategic and critical materials, while that of Defense Plant Corporation (in so far as minerals and metals are concerned) is to provide Government owned plants to be leased for the treatment and manufacture of strategic and critical materials.

The sole aim of the RFC has been from the beginning, and is now, "to aid in financing commerce and industry," and by so doing to save the peoples' money from exploitation, to preserve and use to best advantage our natural resources, and, most important of all, to win the war.

Strontium in Michigan

CELESTITE, or strontium sulphate, occurs in Michigan in scattered crystals and masses in the Sylvania sandstone deposits at Rockwood and presumably elsewhere in Monroe County and also in Wayne County. The State Geological Survey Division has been doing some research work on this mineral in cooperation with the Chemical Engineering Department of the State College, but has been handicapped for lack of funds and personnel under present war conditions. Available deposits encountered during ordinary quarrying operations conducted for the production of glass sand do not seem to offer large possibilities.

Tin Area Mapped

AN AREAL geologic map of the tin district in the Black Range, Catron and Sierra counties, N. M., accompanied by a descriptive text, has been prepared by Carl Fries, Jr., and Arthur P. Butler, of the U. S. Geological Survey. A limited number of photolithographic copies are available upon application to the Director, Geological Survey, Washington, D. C.

What Is the Proper Draw-Point Spacing for BLOCK CAVING?

On it depend the cost of transfer development and maintenance, the amount of ore left after stoping, the production rate, and the safety and efficiency of mining

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IF ONE CONSULTS the projects showing the mining method and ore-transfer system for any of the mines using a block-caving procedure, an appreciation is had of (1) the importance of the ore-transfer system, (2) the large expenditures appertaining thereto from the standpoints of initial costs and maintenance, and (3) the fact that most of the operating personnel will concern itself with transfer development, processing the caved ore for economical transport, and transporting it. Inasmuch as the amount of transfer development work depends on the distance between the draw points in the ore-transfer system, the authors undertook an experimental study, in the barodynamics laboratory at Columbia University, to determine the proper draw-point spacing for given conditions. The results of this study are presented here.

Development work on a block may be considered as consisting of two related parts: (1) That to induce caving action, and (2) That to create the transfer or transport system, so as to move the caved ore to the shaft bottom.

Let us see what the transfer system is like. A generalized section of a block-caving stope is shown in the first of the accompanying drawings. It consists of (1) a block of solid or caved ore, varying from 100 to 600 ft. in height; (2) development work on an undercut level consisting of a series of openings from which the undercut is drilled and blasted. This undercut may be 15 to 20 ft. or more high, and extends over the block area. (3) An ore *transfer system* consisting of draw points (here defined as the intersection of the finger raises with the undercut level), finger raises, a grizzly level, and transfer chutes, which system carries the ore from the stope to the main haulage level, where it is loaded into cars. The ore flow is through the draw points and the finger raises to the grizzly level, where it is broken by sledging, drilling, and blasting so that it may readily pass through the transfer chutes and be loaded into cars.

The basic element in the design of a transfer system is the distance between draw points. A study of the illustration will make it clear that the amount of transfer development work depends on the distance D, which is the draw-point spacing. If this distance were halved, one would require four times as many draw points and grizzlies, twice as many grizzly and main-level drifts, and four times as many chutes for the same block. Present data available for nine mines show that the distance D varies between 11 and 50 ft. The reason for this wide range is neither available nor self-evident, yet it is unquestionably of considerable importance, for it affects both safety and economy of operation.

Factors affecting draw-point spacing (D), from a fundamental standpoint, are:

1. Ore-transfer development costs.
2. Value of ore remaining in stope after mining has been completed.
3. Safety.
4. Production rate per stope.
5. Control of caving action in the block.
6. Maintenance costs.
7. Ore dilution.

With seven factors affecting an answer to a given question, it is evident that the result must be the best compromise available. For, as will be shown in succeeding discussion, some of the factors concerned call for greater and others for a lesser draw-point spacing.

Transfer Development Costs and Value of Ore Left—Of the factors listed, the item (1), minimum cost for ore-transfer development, and (2), minimum value of ore remaining in the stope, provide a starting basis for determining draw-point spacing. The items of safety, production, maintenance, control of caving, and dilution may then be considered.

The statement may now be made that "the draw-point spacing desirable is the one which will give the minimum cost for the sum of the value of the ore left per sq.ft. of stope and the transfer development costs per sq.ft. of stope." This will be discussed in detail subsequently.

Safety—The safety of openings may be determined from a knowledge of the physical properties of the ore; a barodynamic analysis of the forces available and the stresses they induce in and around the openings. If this work is done for a given plan of openings and it is concluded that these openings are unsafe, then the draw-point distance D may be increased so that the safety of the openings is assured. From a safety standpoint there will be no reason for decreasing the distance D.

Production Per Stope—This is affected by the following factors: (1) Quality of broken or caved ore with reference to size. (2) Cross-sectional dimensions of fingers and chutes. (3) Length dimensions of fingers and chutes. (4) Number of fingers and raises. (5) Grizzlies.

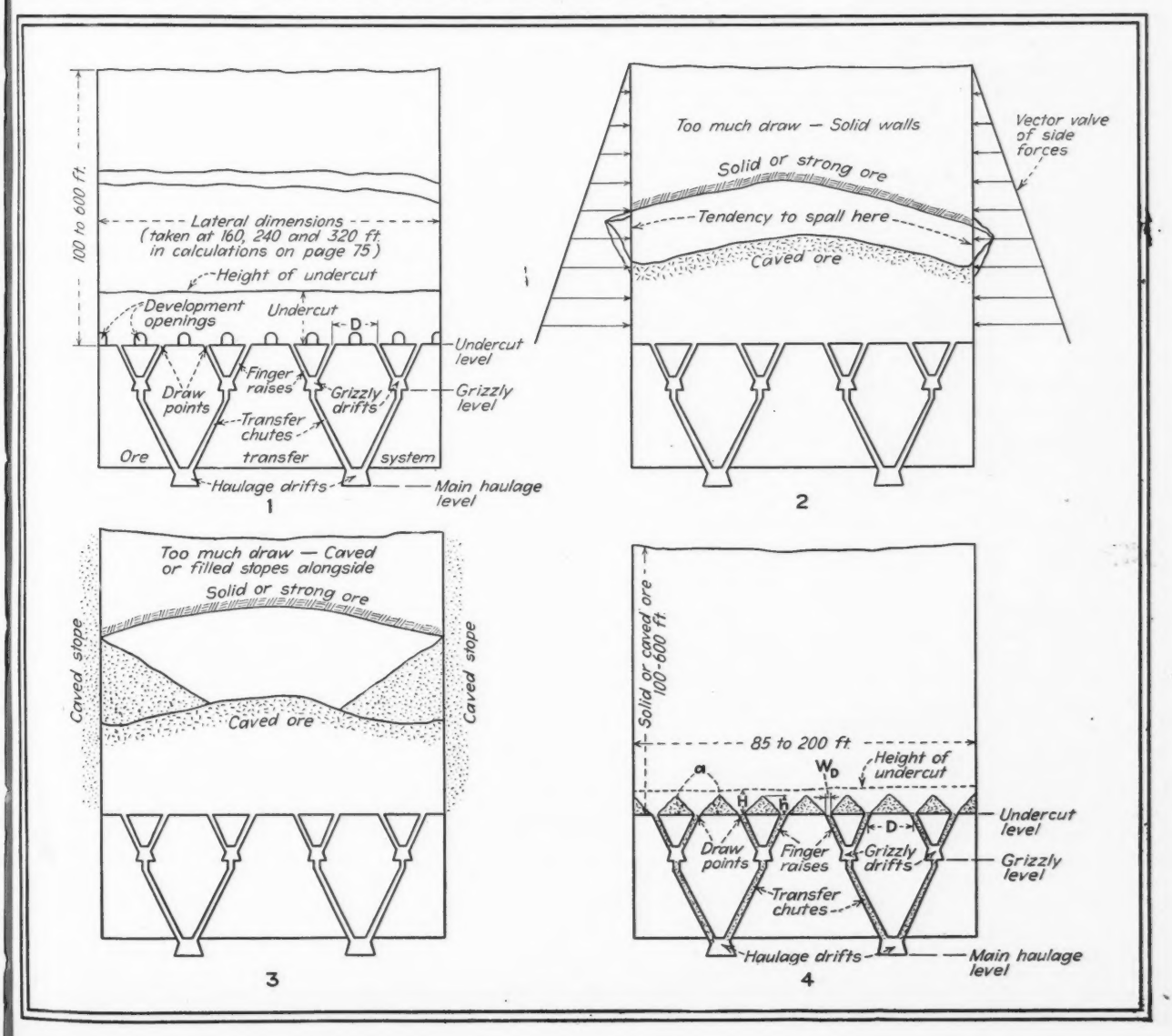
As to the first of these factors—namely, the quality of the broken ore with reference to size—as the ore must pass through openings of a given size—that is, of given cross-sectional dimensions—it follows that the smaller the size to which the material is broken in the stope, the greater the flow per unit of time. If the material is large with respect to the cross-section of the finger raise, an excessive amount of poking, drilling, and blasting in the finger raises will be necessary, besides the additional work on the grizzly. If a study of the ore strengths, fracture planes, and forces available indicates there is considerable likelihood that large percentages of the block will break to large sizes, the advisability of augmenting natural with forced caving must be considered.

As to the cross-sectional dimensions of finger raises and chutes, for a given quality of broken ore, and here the reference is to the size to which the ore has been broken, the quantity that may be drawn through a finger or chute of a given inclination depends on the finger or chute cross-section. Definite information is lacking as to the rate of flow of material of a given size through chutes of various cross-sections, but if the ore is of such a size as to have a tendency to stick in a chute of a given cross-section and inclination, it may be reasoned that the quantity per unit time delivered by a chute with a square cross-section will vary as the cross-sectional area of the chute multiplied by a constant K necessarily greater than 1 (unity).

For example, if a 3x3-ft. chute, requiring poking, drilling, and blasting, delivers 10 tons per day, a 6x6-ft. chute for the same size of material will deliver 36/9x10xK, or more than 40 tons a day. The effort on the part of the chute man to obtain these tonnages will be much less, because the tendency for the material to wedge into place will be less, and if wedged, dislodgment of a portion to start the mass moving will be much easier. Finger-raise cross-sections are particularly important items for consideration if low-cost block caving is to be attained.

In respect to the third factor affecting production per stope—namely the length dimensions of finger raises and

1. A BLOCK-CAVING STOPE in generalized vertical section. The block of ore is shown; also the undercut level and the ore transfer system. . . . 2. STOPE WALLS FAIL as a result of too-rapid drawing of caved ore, resulting in loss of control of vertical boundaries of the block. . . . 3. DILUTION of the caved ore will occur when control of vertical boundaries is lost in stope adjoining workings filled with waste or capping. . . . 4. HEIGHT OF UNDERCUT and draw-point spacing must be such that swell of broken ore in undercut will be drawn off enough to allow further caving



chutes—one may reason that maintenance costs per ton of ore passed through fingers and chutes are directly proportional to the chute perimeter and length, and inversely proportional to the chute area. If C_w is the symbol for chute wear or maintenance per ton of ore passed, the relationship may be expressed as follows:

$$C_w = \frac{\text{chute perimeter} \times \text{chute length}}{\text{chute area}} K$$

where K is a constant to be determined by experiment.

If O = chute perimeter, L = length of chute, and A = chute area, the relationship may be expressed as follows: $C_w = \frac{LOK}{A}$. For example, if a chute 3x3x50 ft. in dimensions is taken as a standard of comparison, its maintenance or wear per ton passed through the chute is

$$C_w = \frac{50 \times 12}{9} K = 66.7K.$$

The maintenance or wear per ton passed for a chute 6x6x50 ft. is

$$C_w = \frac{50 \times 24}{36} K = 33.3K.$$

Therefore the 6x6-ft. chute will require maintenance costs per ton of ore passed that are half that required for a 3x3-ft. chute

Finger-raise length should be as short as possible to facilitate drilling boulders which may wedge in the raise and at the draw point. The raises should be of such cross-section at the draw point as to allow three or more boulders of average-to-maximum size to fall in it. A finger-raise length of 10 ft. should be considered a maximum, so that a man may drill boulders on the undercut level from the grizzly level elevation. If the ore immediately above the grizzly level is weak and requires larger thicknesses left for support, the grizzly level should have artificial support, or other safe means should be provided for attacking boulders wedged part way up the finger.

Chute raise lengths do not give much trouble, because the ore is broken to a size on the grizzly which minimizes wedging. Main or transfer chute raises pass considerable ore, depending on the number of fingers that feed them. In ores which wear easily, consideration should be given to applying wear surfaces to the walls of these chutes.

As to the number of finger raises, the rate of production per stope will increase with the number of raises of a given dimension. This means closer spacing between finger raises or draw points, more of a tendency to break the pillar between fingers and over the grizzly level when blasting boulders, and consequently more artificial support for the grizzly level. Inasmuch as the output per stope will be greater with a quarter of the number of finger raises of twice the cross-sectional dimensions, and as, from a maintenance viewpoint, the fingers should be of minimum number and of as large cross-section as possible, and, from a safety viewpoint, they should be as few and as far apart as possible, it therefore appears reasonable to conclude that the maximum production for a stope will be obtained with the maximum number of finger raises of the largest cross-sectional dimension that may be safely placed in the block.

Grizzlies, the last of the factors affecting production per stope, are of considerable importance, for here the sledging, drilling, and blasting of boulders takes place. The greater the grizzly area available, the greater is the working space available per worker, and the greater the amount of ore that can be put aside for continuous periods of similar work. With manpower the costliest item in mining operations, it is essential that the workman's conditions be made as conducive to high production as possible. The maximum grizzly width will equal approximately the width of the finger. Its maximum length will be governed by the distance between the intersections of the finger raises with the grizzly level. The spacing between grizzly bars should limit the fragment size to a quarter up to a fifth or more of the chute cross-sectional dimension.

Control of Block-Caving Action—Of the seven factors affecting draw-point spacing that were tabulated at the outset, three remain to be considered—namely, control of caving action, maintenance costs, and ore dilution. As to the first of these, control of block-caving action, the function of a finger raise is not only to pass ore but also to control the amount of swell of caved ore after it has broken from the roof or back. In blocks where caving takes place by the action of earth forces alone, an open distance between the caved material and roof or back of uncaved ore must be maintained. This is obtained by drawing off the increased volume or swell attained when the material breaks off the roof. Because caving action is a function of the stresses generated in the block and the time it takes for these stresses to cause failure, the drawing of the caved material away too rapidly will result in a condition shown in drawing 2. Here it may be seen that the stope walls are partly unsupported, and as horizontal forces act on these walls (see A.I.M.E. Block Caving Symposium, page 9), they fail, with the result that control of the vertical block boundaries is lost. If a block is being caved next to a previously caved stope full of capping or waste rock, result will be as in 3.

Various expedients to control the vertical block boundaries are in use, the best known of which are shrinkage stopes and a system of fringe drifts. With fringe drifts it is understood that pillars of ore are left between blocks in an effort to stop dilution. A slow draw decreases the production rate per block but is conducive to better caving action in strong ores.

It is the opinion of the authors that the draw in a block during the caving period must be controlled, and observed in order to be controlled. A series of experiments are to be undertaken to determine a procedure. Experiments already concluded on other phases of block-caving operation lead to the statement that the control of the behavior of the top surface of the caved ore may be had with a relatively small number of finger raises.

Maintenance Costs—This factor has probably been sufficiently discussed under the items concerned with finger raises and chutes. At the risk of repetition it may be stated that maintenance costs per ton of ore mined will vary directly as the number and lengths of chutes and fingers and inversely as their cross-sectional areas. The conclusion from this statement is that "for low maintenance costs the draw-point spacing and cross-sectional dimensions are as large as possible."

Ore Dilution—The problem of ore dilution becomes of importance when mining blocks adjacent to caved blocks, when capping is present, or when back fill is used. It is a problem peculiar to each mine and may be considered in two stages:

1. The dilution problem when controlling the caving action in the block.
2. The dilution problem after the block has completely caved and (a) the capping comes with it, or (b) back fill is placed on the surface of the caved ore and follows it down.

Questions may be raised now as to whether dilution is affected by (1) the size of broken capping or fill in relation to size of broken ore; (2) the drawing procedure (should it be uniform? follow some sequence? or may it be from any point in any amount up to the appearance of fill or capping?); and (3) whether dilution is controlled by number of draw points available.

Experimental work was carried on for a completely caved block, with back fill of a smaller size than the caved ore. It was found that the amount of dilution was the same and low (within 5 percent experimental limits) for low and high stopes, so that the percentage dilution in a high stope was small. It was also found that for these conditions the number of draw points, rate of draw, and sequence of draw had little effect on dilution. This experimental work will be referred to further on.

Determining the Draw-Point Spacing—Let us now repeat, for the purpose of discussing it, the fundamental statement made earlier in the article, with respect to draw-point spacing. It reads: "The draw-point spacing desirable is the one which will give the minimum cost for the sum of the value of the ore left per sq.ft. of stope and the transfer development costs per sq.ft. of stope."

General procedure for determining draw-point spacing is as follows: (1) Determine the amount of ore left per sq.ft. of stope in tons for a given draw-point spacing. (2) Determine the value per ton of the ore left. The product of (1) and (2) is the value of ore left per sq.ft. of stope.

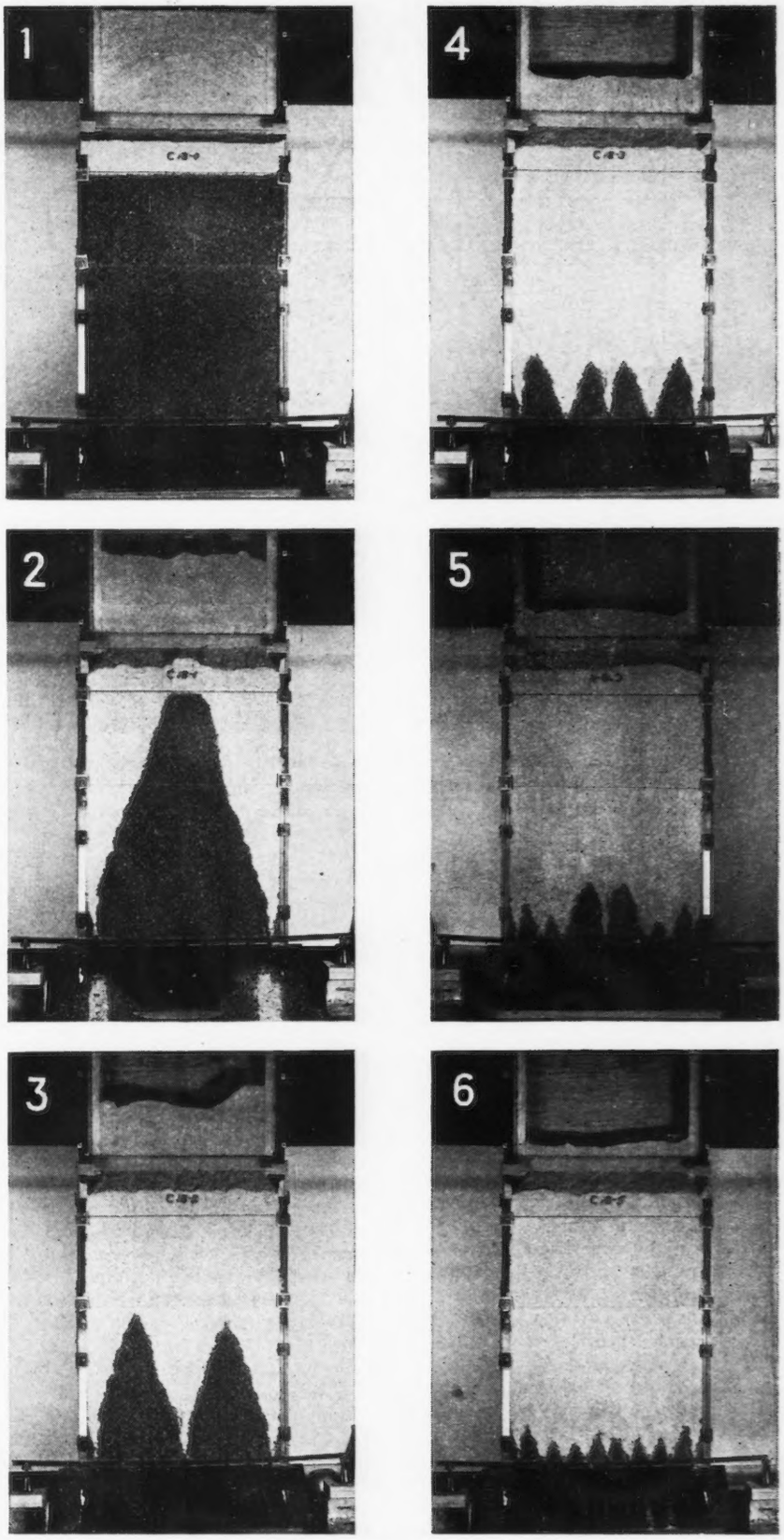
For example, with 20-ft. draw-point spacing, 0.46 ton per sq.ft. is left after mining has been completed in the stope. If the value of the ore is $2 per ton, the value of the ore left per sq.ft. of stope is $0.92. This calculation may be made for a draw-point spacing of 10 ft., 30 ft., 40 ft., etc. One may now plot "value of ore left per sq.ft. of stope" against "distance between draw points in feet," as in the graph shown on p. 74. This may be done for ore of any value. The curves plotted are for values from $2 to $2.50 per ton.

Transfer development costs per sq.ft. of stope for a given draw-point spacing may now be obtained from lengths and cross-sections taken from plans of the transfer development work required, assigning unit costs and determining the total costs for a block with given lateral dimensions. The total cost divided by the cross-sectional block area gives the cost per sq.ft. for a given draw-point spacing.

For example, the total cost for transfer development for 20 ft. draw-point spacing equals $95,520 for a 160x160-ft. stope. The costs per sq.ft. of stope equal $95,520 divided by 160x160, or $3.73. This calculation may be repeated for varying spacing.

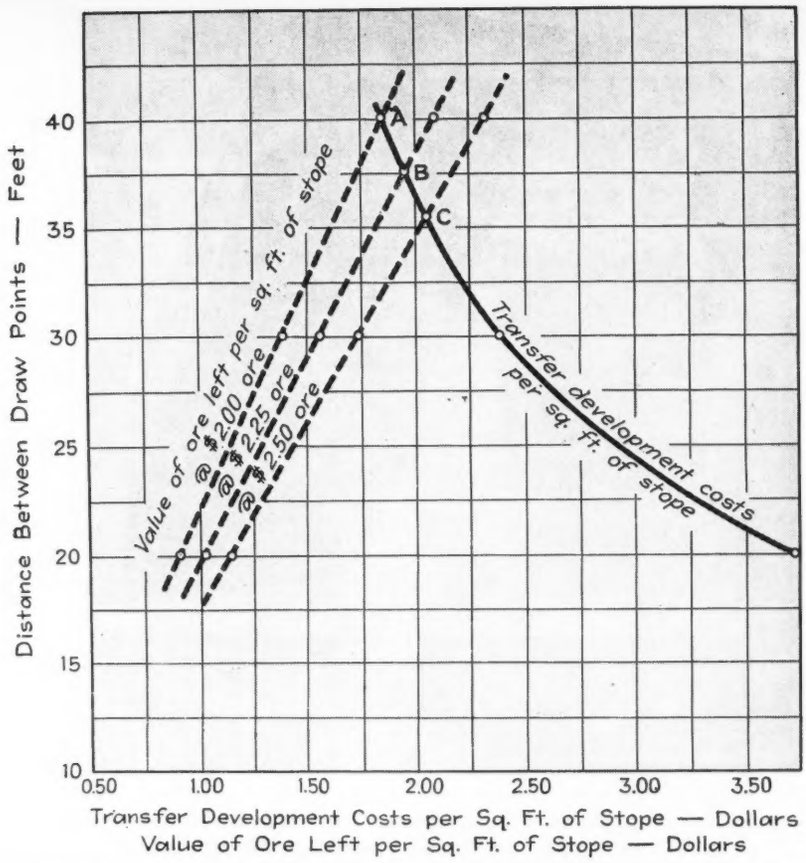
The transfer development costs per sq.ft. of stope may now be plotted against the distance between draw points in feet, as in the graph. In the curve, as plotted, the intersection of the "value of ore left per sq.ft. of stope" curve and the "transfer development costs per sq.ft. of stope" curve, as at points (A), (B), and (C), gives the points at which the sum of the cost per sq.ft. of stope for both transfer development and the value of the remaining ore is the least, and consequently the draw-point spacing desirable. (This may be proved by mathematical derivation). For example, these curves show that for $2.50 ore the draw-point spacing shall be on 35½-ft. centers; for $2.25 ore, on 37½-ft. centers; and for $2 ore on 40-ft. centers.

If the draw-point spacing, as deter-



DRAWING PROCEDURE in a completely caved block, where the ore is followed by back-fill, is demonstrated in six sucessive stages with this model. This shows what happens where a given drawing sequence is used for a given number of draw points. Ore being drawn shows as black; the white material, drawn from the upper receptacle, represents mill waste used as filling. Amount of ore left in stope in these tests was the same regardless of drawing sequence

(See page 74)



DISTANCE BETWEEN DRAW POINTS that will give minimum sum of transfer development cost and value of remaining ore may be determined from from this graph. The intersection of the two curves gives the desired spacing

Cost Data Used in Making Graph

Distance Between Draw Points, Ft.	Development Costs ($) per sq.ft. of Stope	Value of Ore Left ($) per Sq. Ft. of Stope ($) 2.00	2.25	2.50
20	3.73	0.92	1.035	1.15
30	2.39	1.39	1.56	1.74
40	1.85	1.86	2.09	2.32

mined from the seven factors already cited, does not provide safe or large enough openings as determined by barodynamic study, the spacing must be increased to meet these conditions, but at an added cost for the sum of ore values left in the stope and transfer development costs.

If, on the other hand, the above draw-point spacing does not provide the desirable production rate, and barodynamic studies show that more and larger openings may safely be placed at shorter intervals, then the spacing may be decreased. This reduction will result, however, in a larger total cost per sq.ft. of stope for the sum of the transfer development costs per sq.ft. of stope, the value of ore left per sq.ft., and the maintenance costs.

Specific procedure for determining draw-point spacing is as follows:

Each mine is a particular problem. Indeed, one often finds that each block in a mine is a particular problem. It is essential, therefore, that the factors to be dealt with in determining the draw-point spacing be specified as closely as possible.

For purposes of this discussion the following conditions are assumed: (1) The orebody is large in extent. (2) It outcrops on the surface. (3) Caving may be natural or forced. (4) The first block only is to be considered. (5) Back fill, consisting of mill tailings, is to be placed over the block and kept at a given surface elevation as the ore is drawn. (6) Ore and tailings are dry.

We have now to determine:

1. The minimum draw-point spacing to insure caving action in the block.

2. The ore value left with any given draw-point spacing.

3. The ore dilution.

To determine the spacing that will insure caving action, the angle of repose of the caved material (dry and wet if necessary), and the amount of swell or increase in volume of the broken ore, must be ascertained. This can be done by experiment.

The angle of repose of broken material may be determined from banks of broken ore, or in the laboratory.

The increase in volume, or swell, may be obtained as follows: Weigh a solid piece of ore in water and air. The difference in weight is equal to the weight of the volume of water displaced, which in turn is equal to the volume V_s of the piece of solid ore. The piece of ore is now crushed and its volume V_B is measured in a graduated device of any kind. $\frac{V_B}{V_S} - 1$ is equal to the increase in the volume or swell per unit of solid. If V_B= 7.5 cu.in. and V_s=5 cu.in., then the increase in volume per unit of material $= \frac{7.5}{5} - 1 = 0.5$—i.e., 50 percent.

Height of undercut bears a relation to draw-point spacing. If one refers to drawing 4, it will be observed that to be sure the swell of broken ore in the undercut will be drawn away sufficiently to allow further caving of the back, the height of the undercut (H) and the minimum distance between draw points must be such that the height of the peak of the triangular section of remaining ore (h) shall be less than the height of the undercut. The angle alpha (α) for complete drawing of ore equals the material's angle of repose. If D is the distance between draw-point centers, W_d=draw-point width, and α =angle of repose, then

$$h = \frac{D - W_d}{2} \tan \alpha$$

H, the height of undercut, must be greater than h. Allowing a 25 percent factor of safety and to provide for keeping fingers full of broken ore so as to protect them and the chute men, the equation may be written as follows: (H=the height of undercut)

$$H = \frac{1.25\,(D - W_d)}{2} \tan \alpha$$

If one assumes a draw-point spacing of 35 ft., a draw-point width of 5 ft., and that α=45 deg., then the height of undercut required becomes:

$$H = \frac{1.25\,(35 - 5)}{2} = 18.75 \text{ ft.}$$

The amount to be drawn from each finger raise may then be calculated. It is essential that equal and correct amounts be drawn from each finger to insure the start of caving action in the block.

The point to be stressed here is that the relationship $H = \frac{K\,(D - W_d)\tan\alpha}{2}$ where a constant K is now substituted for 1.25, shows that the draw-point spacing may be varied by varying the undercut height H.

After caving action has proceeded a short distance up the block, to insure further caving action within the block boundaries, *drawing must proceed in a manner determined by experiment, as the angle of repose of the material no longer controls.* (The experiments upon which this statement is based are not held to be within the province of this paper, but it is hoped to describe them later.)

Experiments With a Stope-Block Model—Experimental procedure for determining the amount of ore left, and the amount of dilution as affected by draw-point spacing and drawing, is as follows:

Photos 1 to 6 on p. 73 show the model used in the experiments for determining (a) drawing procedure, (b) the amount of ore remaining in the stope, and (c) the dilution, when drawing a completely caved block followed by back fill from the surface. The back fill consisted of mill waste of smaller size than the ore.

These pictures show what takes place when a given drawing sequence is used for a given number of draw points. In addition to the drawing sequence illustrated, a uniform draw (that is, where the drawing is done from all fingers at the same rate) and various other sequences were used.

In all cases the following was observed:

1. The amount of ore left was, for practical purposes, the same—that is, the amounts did not vary by more than 5 percent.

2. The amount of dilution was negligible and took place only at the end of the draw from any finger. It could be definitely controlled.

3. The angle formed between ore-fill contact and the horizontal varied from 68 to 72 deg. Although the contact line is curved, it may be taken as straight for estimating, although more accurate results will obtain if the areas included by the contact line are considered.

Conclusions reached on the basis of the experimental data for the conditions described are:

1. Drawing of ore may take place at any time from any finger and in any amount without affecting materially (a) the amount of ore remaining, (b) the support given to the sides of the block, or (c) the dilution by the back fill.

2. The amount of infiltration of fill into the broken ore is small and negligible, when the block volume or height is considered.

3. The volume of ore remaining depends on the distance between drawpoint centers and may be reasonably estimated from the experimental angle obtained between horizontal and ore-fill contact line.

4. A basis for determining the amount and value of the ore left after mining is available.

Calculation of Value of Ore Left and Transfer Development Costs—As to the value of the ore left in the stope after mining has been completed, if it sells for, or is worth $2 per ton on the car at the shaft head, the value of the broken ore remaining in the mine is equal to $2 minus the sum of the grizzly breaking costs, haulage costs, and hoisting costs, because all the other expenses relative to the remaining ore have been incurred. As the ore left is usually that broken with the undercut blast, it is therefore finely broken and requires little secondary blasting or grizzly work. The value per ton of the ore left may therefore be taken as the value at the shaft head minus the sum of the haulage and hoisting costs.

CALCULATION OF TRANSFER DEVELOPMENT COSTS PER SQ. FT. OF STOPE AND VALUE OF ORE LEFT

for Draw Spacings of 20 Ft., 30 Ft., and 40 Ft., Respectively and Block Dimensions of 160 x 160 Ft., 240 x 240 Ft., and 320 x 320 Ft. Respectively

DRAW POINTS AT 20 FT. CENTERS

This requires a block whose lateral dimensions are a multiple of 20 ft. and for these calculations a block 160x160 ft. is chosen. See drawing 1.

TRANSFER DEVELOPMENT COSTS

4 Grizzly drifts, strongly supported	$64,000.00
64 Finger raises	5,120.00
2 Haulage drifts	4,800.00
16 Chutes	21,600.00
Total estimated development costs	$95,520.00
Estimated tonnage remaining	11,800
Tonnage remaining per sq. ft. of stope	$= \frac{11,800}{160 \times 160} = 0.46$
Value of ore left per sq. ft. of stope	= at $2.00 = $0.920
	= at $2.25 = 1.035
	= at $2.50 = 1.150
Development costs per sq. ft. of stope	$= \frac{95,520}{160 \times 160} = \$3.73$

DRAW POINTS AT 30 FT. CENTERS

This requires a block whose lateral dimensions are a multiple of 30 ft. and for these calculations a block 240 x 240 ft. is chosen. See drawing 1.

TRANSFER DEVELOPMENT COSTS

6 Grizzly drifts	$96,000.00
64 Finger raises	8,000.00
2 Main haulage drifts	7,200.00
16 Chutes	28,400.00
Total estimated transfer development costs	$137,600.00
Ore tonnage remaining	40,000
Tonnage remaining per sq. ft. of stope	$= \frac{40,000}{240 \times 240} = 0.695$
Value of ore left per sq. ft. of stope	at $2 = $1.39
	at $2.25 = $1.56
	at $2.50 = $1.74
Transfer development costs per sq. ft. of stope	$= \frac{137,600}{240 \times 240} = \$2.39$

DRAW POINTS AT 40 FT. CENTERS

This requires a block whose lateral dimensions are a multiple of 40 ft. and for these calculations a block = 320 x 320 ft. are chosen. See drawing 1.

TRANSFER DEVELOPMENT COSTS

4 Grizzly drifts	$128,000.00
64 Finger raises	10,240.00
2 Main haulage drifts	9,600.00
16 Chutes	41,600.00
Total estimated transfer development costs	$189,440.00
Ore tonnage remaining	95,000
Tonnage remaining per sq. ft. of stope	$= \frac{95,000}{320 \times 320} = 0.93$
Value of ore left per sq. ft. of stope	at $2.00 = $1.86
	at $2.25 = $2.09
	at $2.50 = $2.32
Development cost per sq. ft. of stope	$= \frac{189,440}{320 \times 320} = \$1.85$

The value of the ore left per sq.ft. of stope equals the tonnage left per sq.ft. of stope multiplied by the value per ton at the shaft head.

Procedure followed in calculating

(*Continued on page* 130)

Rough Milling Followed by Central Milling

Prolongs Life of Wisconsin Lead-Zinc District

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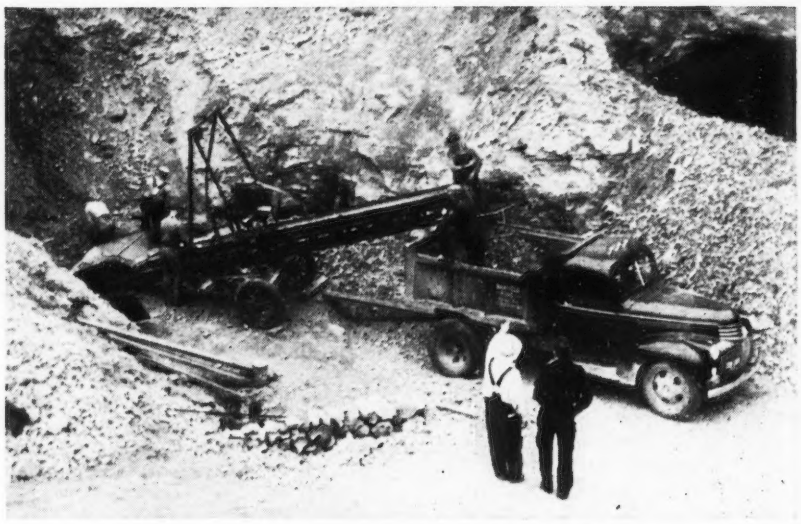
▶ *This account will be of interest not only because it gives an accurate description of Platteville district milling, but because the practice of rough-milling at or near the mine, then shipping the rough concentrate to a centralized finishing mill, is likely to have widespread future application. Such operations are appropriate where a district contains deposits too small to justify a complete mill or where depletion is advanced to the point where a mine can no longer support a full-scale milling operation.*



"GRASS-ROOTS" ore is hand-sorted here as it is loaded into a truck by a belt loader at the old James mine, operated by Gill Brothers

ZINC AND LEAD have been produced for many years in the Galena-Platteville district of southwestern Wisconsin and adjacent parts of northwestern Illinois and northeastern Iowa since early explorers learned from the Indians that deposits of lead ore showed at the surface. At present important production is confined to the State of Wisconsin with two exceptions—the North Unity and Hughlett & Gray mines, which are situated just south of the Wisconsin-Illinois boundary. In the near future one or two other properties may be developed in Illinois.

The district is producing about 2,000 tons per month of 60 percent zinc concentrates, of which the Vinegar Hill Zinc Co. finishes about 80 percent, and the Dodgeville Mining Co. and W. E. Faithorn the remainder. Vinegar Hill produces about 100 tons per month of 78 percent lead concentrates and 1,000 tons per month of marcasite and pyrite. Zinc concentrates from the district are shipped to smelters at LaSalle, Danville, and East St. Louis, Ill. Lead concentrates are shipped to Alton and Hillsboro, Ill. The marcasite and pyrite are used in the manufacture of sulphuric acid by the Vinegar Hill Zinc Co.

Currently, about 80 percent of the mill heads received by Vinegar Hill for finishing are hand-sorted "dirt," averaging 8 to 10 percent zinc, and the remainder is wet-milled rough concentrate averaging 20 percent zinc.

The bonus payments to mine operators producing lead and zinc ores, made by Metals Reserve Co. for the federal government, have been a great stimulus to productive activity, and should result not only in increased production but in new discoveries.

The mining district is in the Driftless Area, and consequently is maturely dissected and well drained, consisting in general of well-rounded hills carved out of the local limestone. The hills are clothed in forest, largely deciduous, where they have not been cleared for crops or pasture land. The area is liberally cut by gravel, macadamized, or concrete roads, bringing all-weather trucking facilities close to all of the mines. The area is served by the Chicago, Milwaukee & St. Paul, Chicago & Northwestern, and Illinois Central railroads.

Principal surface rocks are the Galena and the Platteville dolomitic limestones of Ordovician age. The geology is relatively simple, the surface rocks dipping gently southwest away from the Wisconsin arch with an average dip of about 20 ft. per mile. The rocks are gently folded in many places and also fissured and fractured, with some evidence of slippage, but in no case have I seen positive evidence of vertical displacement of even 5 or 10 ft.

It has been stated that the parting of carbonaceous shale, locally called "oil rock," near the base of the Galena formation "generally marks the base of ore deposition in the district." At this time, however, several mines are working "glass rock" runs in the upper part of the Platteville formation which underlies the Galena formation. However, very few mines have shafts more than 200 ft. deep and some ore is being mined open-cast. In the early days much residual galena was found on the surface.

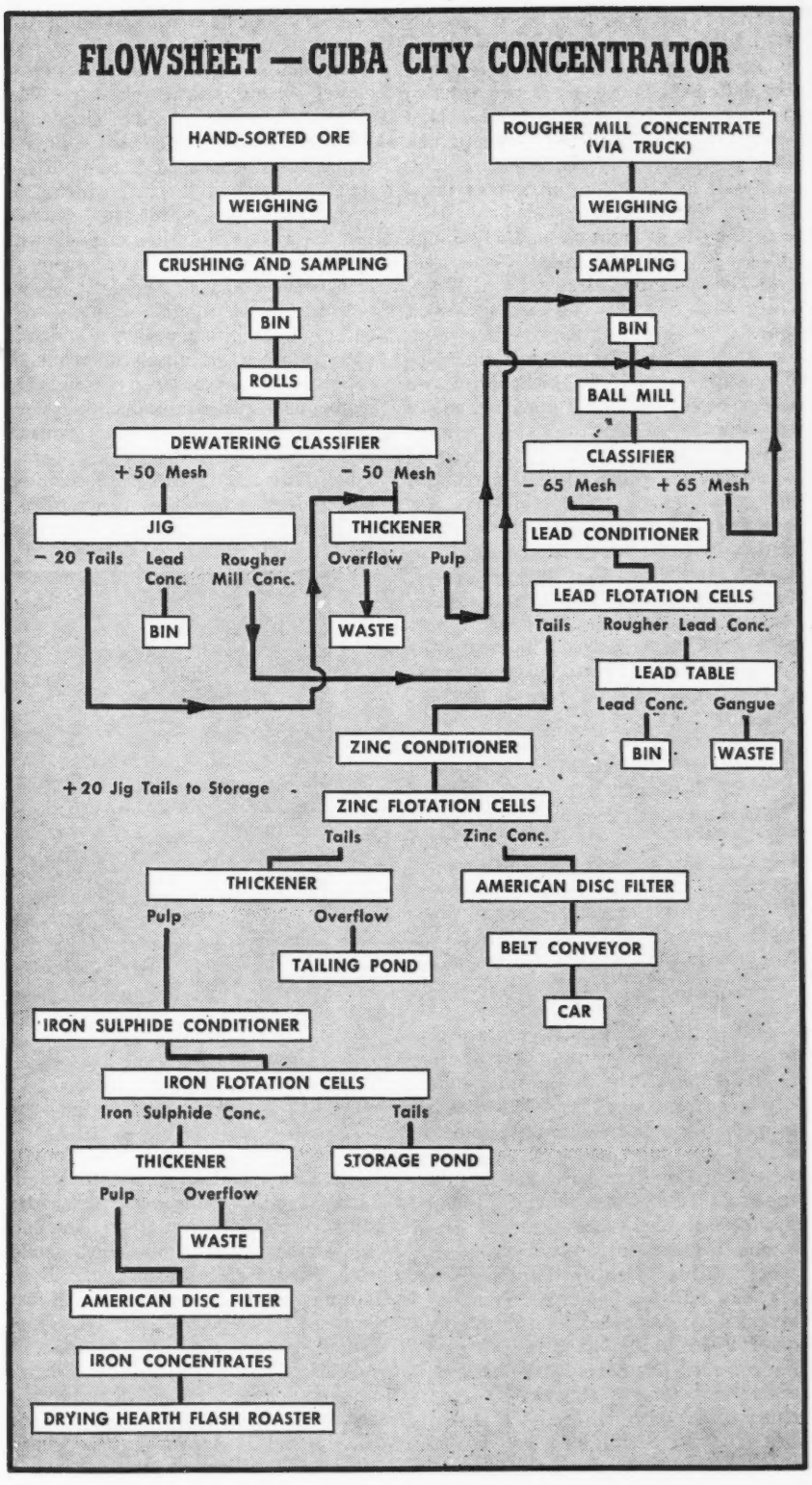
The mineralogy of the ores is relatively simple as compared to Western zinc and lead ores and resembles that of the Tri-State district. In general the ore consists of sphalerite, galena, marcasite, and pyrite, with a gangue of coarse secondary calcite locally called "tiff," and of course the country rock of dolomitic limestone. Some ores also contain barite, which offered a formidable milling problem in pre-flotation days, and locally contain

traces of copper minerals, malachite and chalcopyrite. A limited amount of smithsonite (drybone ore) is still mined in the area.

With modern flotation equipment, separation of marcasite and sphalerite is a relatively easy operation, but in pre-flotation days the situation was different. Concentrates containing high percentages of iron sulphide were and are referred to as "green" ore. The specific-gravity differential between the iron sulphide and the zinc sulphide is not great enough for efficient gravity separation in jigs and on sand and slime tables. Many operators formerly gave the green concentrate a skin roast whereby the outer surfaces of the sulphide particles were rendered magnetic. The iron sulphide was then magnetically separated from the sphalerite, making a high-grade zinc product and an iron sulphide concentrate which was marketable at sulphuric acid plants. However, in the roasting of green jig concentrate a loss of about 3.5 percent of zinc in the form of small particles blown out the stack was experienced. As marcasite commonly crumbles and breaks down very readily when ore is crushed for wet milling, there was usually much iron sulphide associated with the finely divided sphalerite which would in great part escape the jig, but would be concentrated on tables. However, so great was the stack loss in the skin roasting of this fine product, that magnetic separation of table concentrate did not prove economically justifiable in most cases and few operators installed sand or slime tables in pre-flotation days.

The Wisconsin zinc and lead district is rather unique in that most operators make only a rough concentrate at the mine and sell it to a centrally located custom mill, the Vinegar Hill Zinc Co. plant at Cuba City, where the ore is made into a 60 percent zinc concentrate suitable for marketing. Some individual operators merely hand-pick the mine-run dirt on the grizzlies, and others make a rough concentrate by jigging or jigging and tabling.

There is considerable divergence of opinion as to the relative economies of the various methods of handling the ore. Those who merely hand-sort on a grizzly to make a rough concentrate before trucking to the custom mill claim that their losses by attempting to wet-mill would more than offset any saving effected in hauling and treatment charge which would result from wet-milling to a richer concentrate. Operators of wet mills believe that by concentrating they effect transportation and treatment charge economies, especially in the handling of low-grade ores. The average contract price for truck hauling in the area is $0.06 per ton-mile. Obviously, the places where hand-sorting would be feasible would be fairly close to the finishing mill, where haulage costs are relatively small.



TREATMENT of the hand-sorted ore and the rougher lead concentrates is shown. Of interest is the fact that the rougher lead concentrates are tabled.

At present there are only two small operators in the district who employ flotation and do not ship rough concentrates to Vinegar Hill for finishing. These are the Dodgeville Mining Co., operating near Dodgeville, handling mine ore, and the W. E. Faithorn mill, which re-treats old tailings of the Champion mine, near New Diggings.

For several years attempts have been made to re-treat tailings in the district as is done on a large scale in

the Tri-State area, but until the advent of federal bonuses they were unsuccessful because of the low tenor of the material. However, at present two tailings mills are operating and a third mill is being considered. One of the two, the 700-ton W. E. Faithorn mill, makes a finished concentrate as mentioned. Feed averaging about 1½ percent zinc is brought from the tailings pile by a 3½-yd. hydraulically operated, two-wheel scraper, drawn by a 60-hp. caterpillar tractor. The feed goes to a Dorr drag classifier, the oversize passing to a Harz type rougher jig. Undersize goes to a 15 ft. thickener, whose underflow is fed to the tables. The jig concentrate is fed to an Esperanza classifier, the undersize of which is thickened for table feed, the oversize being ball-milled. The tables make a tailing and a concentrate, which is also sent to the ball mill. The ball mill, in closed circuit with a drag classifier, feeds a zinc flotation circuit, which makes a tailing and a finished 60 percent zinc concentrate. The lead content of the mill feed is too low to warrant attempts to recover a lead concentrate.

Screen tests of typical tailings show that over 70 percent of the zinc is in material finer than 3/10 in. Therefore it seems likely that some economic advantage might be obtained in screening the tailings used for mill feed at about this size and discarding the oversize. If this is correctly done, an overall recovery of about 50 percent seems feasible and a considerable reduction in milling costs. The W. B. Baggley mill, the only other tailings mill now operating in the district, employs this principle, discarding the oversize from a ⅜-in. trommel, and feeding the undersize to a rougher jig. The coarser rougher jig concentrate is cleaned to a zinc-iron concentrate on a cleaner jig. Overflow from both jigs is thickened in a 10-ft. cone and the thickened product is tabled to make a tailing and a zinc-iron concentrate. The zinc-iron concentrates are shipped to the Vinegar Hill mill for finishing. The Baggley mill is near Benton. It operates on a 24-hr. basis, handling about 22 tons of feed per hour. The rough concentrate averages about 25 percent zinc and 19 percent iron.

At the Dodgeville mill, which has a capacity of 16 tons per hour, ore is fed to the mill hopper through a grizzly, on which two men discard such low-grade rock as stops on the grizzly after cobbing off any conspicuous values, and break up any lumps of ore too large to pass the grizzly. From the bin, ore passes to a jaw crusher and then to rolls in circuit with a ⅝-in. trommel. The trommel undersize is fed to a shaking screen, whose oversize is rougher jigged and whose undersize is ball-milled. The jig makes a finished lead concentrate, a tailing, and a rough concentrate, which is also ball-milled. The ball mill, in closed circuit with a rake-type classifier, prepares the feed for the lead flotation circuit. The lead flotation concentrate is fed to a table to free it from the "oil rock," which floats with the galena. Flotation tails are fed to a zinc flotation circuit, which makes a finished zinc concentrate. No iron concentrates are made.

Typical wet rough milling practice employs jaw crushing; rolls and trommel; rougher jigging to produce a rough lead concentrate; a rough zinc-iron concentrate and tails; a single-cell lead cleaner jig; a drag classifier to remove fines before jigging; and a table. The table treats both the classifier undersize and the jig overflow to make a rough concentrate and a tailing. The mill at the old Coughlin mine, near Shullsburg, and that at the Little Benny mine, near New Diggings, typify this practice. The small mill at the 4 S & B mine, near Dodgeville, uses jigging but no table. Rough milling concentrates are likely to run from 15 to 40 percent zinc. Lead and iron will vary from mine to mine.

A number of mines in the district employ only "grizzlying", hand sorting, and cobbing to make a rough concentrate, which is shipped to the Vinegar Hill mill. Mines using this practice include the Piquette, DuRocher, Meloy & Baker, McCabe, B.A.T., James, Mullin, Doyle-Harty, Hughlett & Gray, and North Unity mines.

Vinegar Hill Zinc Co. is not now operating mines in this area, but its custom mill, operated in conjunction with its sulphuric acid plant at Cuba City, produces 80 percent of the finished zinc concentrate for the whole district.

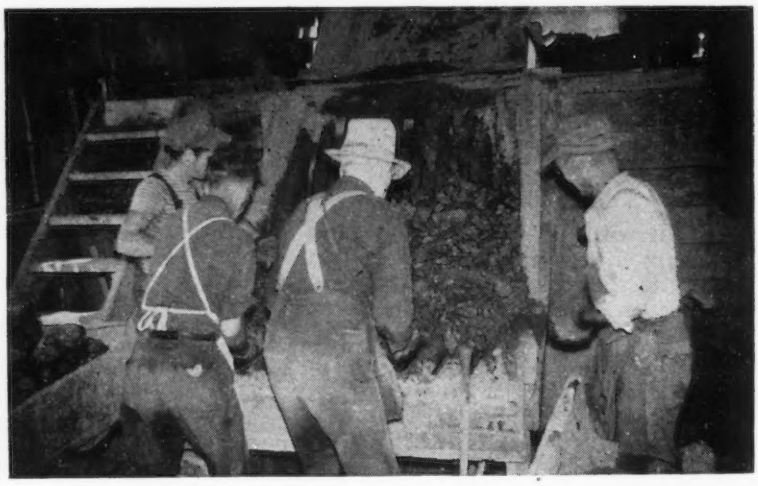
Electric power is used, purchased from the local power and light company.

Water for the mill is supplied by wells driven into the St. Peter sandstone and even deeper.

The incoming ore is sampled, weighed, and unloaded from trucks into the rough-ore storage bin. From the storage bin ore is elevated to a trommel screen and 30-in. rolls in series. Oversize (over ⅝ in.) returns to the rolls, and undersize feeds to the center cell of a 9-compartment Harz-type jig. The center cell is 42 x 30 in. and the others are 30 x 36 in. The jig flows each way from the center; the three central compartments have ⅞-in. screen and the others ⅜-in. screen.

Rougher jig concentrates are elevated by a bucket elevator to an Esperanza dewatering drag. Tails from the jig go to a 60 x 38-in. vibrating screen perforated with ⅜-in. holes. Oversize from the vibrating screen is elevated and spouted off to tails, and undersize goes to a drag classifier from which the oversize is elevated to the 40-ton sheet-iron ball-mill feed hopper. Overflow or fines go to a 30-ft. diameter concrete thickener. The dewatered oversize from the Esperanza is also elevated to the ball-mill feed hopper, and the overflow is pumped to the 30-ft. concrete thickener. Thickened slime from this tank, all minus ⅛-in. mesh size and averaging about 5 percent zinc, is pumped directly to the ball mill.

Two ball mills are used for final grinding. Each is in series with an auger type classifier laid at an angle of about 12 deg. from the horizontal. The larger of the two ball mills is of 3-ton capacity and has a feed of 4½ tons per hour. It is run by a 75 hp. electric motor. Its classifier is about 20 ft. long and 30 in. in diameter.



"GRIZZLYING" and hand-sorting zinc-lead ore at the Meloy and Baker mine in the southwest Wisconsin district

The smaller ball mill has a feed capacity of 2/10 tons per hour. Its auger classifier is about 12 ft. long and 24 in. in diameter.

The 40-ton hopper feeds both ball mills. Soda ash, 39 lb. per hour, is added in the ball mills. Oversize from the classifiers is returned to the ball mills and the pulp, under 65 mesh, overflows to a 6-ft. conditioner, from the large ball mill. Aerofloat, 8 lb. per hour, is added at the head of the large classifier; 3 lb. per hour is added at the head of the small classifier. Cyanide, 1.75 lb. per hour at the big mill and 0.56 lb. per hour at the small mill, is also added at this point. In the conditioner for the large ball mill, half and half cresylic and pine oil, 0.18 lb. per hour, is added, but none is added to the small ball mill conditioner.

LOADING TAILINGS at Vinegar Hill Zinc Co. mill. "Dead" tails sell at 30 to 45¢ per cu.yd. in the Wisconsin zinc area

Pulp from both conditioners feeds through a 5-in. iron pipe to a sump where it is pumped to the first rougher cell of a four-cell lead flotation circuit. The two rougher cells return to the first two cells, which are cleaner cells. The lead flotation circuit is made from $\frac{3}{16}$-in. sheet iron except for the wooden launders. The cells measure 60x44 in. The lead flotation concentrate is pumped to a 16-ft. table, where it is freed from oil rock. A 78 percent lead concentrate ready for market is finished on the table.

The tails from the lead flotation circuit are fed to a 9-ft. conditioner. In the conditioner, half and half cresylic and pine oil 0.49 lb. per hour; lime, 9 lb. per hour; copper sulphate, 20 lb. per hour; and xanthate are added. From the conditioner the pulp is fed to the second cell of the seven-cell zinc flotation circuit, which is constructed like the lead circuit. The first and second cells are cleaner cells and sometimes the second cell froth flows to the first cell to build up the grade of the finished concentrate. An emergency drip pot of cresylic is mounted over the launder, and emergency pots of xanthate are mounted over several weirs to raise zinc if the tails begin to run too high in zinc. The flotation concentrate is dehydrated by pumping it to a disk filter. A conveyor belt takes it out of the mill and to a "flipper" car loader. This endless belt moves at high speed, throwing a fine stream of zinc concentrate into even the far corners of a box car. About 50 tons of 58 to 61 percent zinc concentrates are loaded every 24 hr.

The tails from the zinc flotation circuit are pumped to a 30-ft. thickener like the one previously described but constructed of sheet iron instead of concrete. Thickened pulp (37 to 50 percent solids) is raised by a diaphragm pump and fed to a conditioner (6 ft. in diameter and 6 ft. high) agitated by a 5-hp. motor. Sulphuric acid, 20 lb. per hour; copper sulphate, 1.65 lb. per hour; creosote, 0.65 lb. per hour; and "KAX" xanthate, 1.45 lb. per hour, are added in the conditioner. The conditioned pulp feeds to a nine-cell marcasite and pyrite flotation circuit, the first five cells of which are cleaners and the last four rougher cells. The tails from the first "iron" flotation circuit feed to a catch box, where KAX xanthate is added, and thence to a six-cell auxiliary "iron" flotation circuit consisting of two cleaners and four rougher cells. The tails are raised and flumed to a waste pond, where they accumulate as lime of agricultural quality. Concentrate from the second "iron" flotation circuit is returned to the first circuit for final cleaning. The tails from the second circuit are automatically sampled by a baffle or deflector, which swings periodically through the stream of tailings, deflecting a portion into a sampling container. The iron sulphide concentrate, consisting largely of marcasite and pyrite, is pumped to a filter and dried, preparatory to conversion to sulphuric acid in the acid plant.

A detailed discussion of the manufacture of sulphuric acid would be out of place in a paper devoted primarily to milling practice, but inasmuch as the operation of the Vinegar Hill acid plant at Cuba City makes possible the economic utilization of much of the marcasite and pyrite mined with sphalerite and galena in this area, and in some cases by its sale value makes possible mining of zinc and lead which might otherwise not be economically recoverable, it may be interesting to trace briefly the conversion of the iron sulphide to the very important industrial acid.

Filtered marcasite and pyrite (FeS_2) are given a flash roast in a modified Wedge furnace. The sulphur dioxide thus freed is cleaned in settling pipes and by a Cottrell precipitator, then cooled in lead pipes which are exposed to atmospheric temperature in winter and water-cooled in summer. The sulphur dioxide is then washed in a lead tower filled with quartz, by water which is warm enough so that little H_2SO_3 (sulphurous acid) is formed. The SO_2 is then freed from water by washing with sulphuric acid in another lead tower, and further cleaned by passing through glass wool made from blast-furnace slag. It is now forced by a blower to a converter and raised to a temperature of 420 deg. C. partly in U-tubes and partly by being passed through a heat exchanger. In the converter SO_2 is combining with oxygen to form SO_3 and, the reaction being exothermic, heat from the SO_3 is transmitted to the SO_2 which is passing through the heat exchanger. The SO_2 at 420 deg. C. in the presence of a patented catalyzer combines with oxygen to form SO_3. Converter pipes are made of high-silica steel. The SO_3 is passed into concentrated sulphuric acid to build up the SO_3 content of the acid, which is stored in iron chambers. The acid plant produces $1\frac{1}{2}$ tank cars of concentrated sulphuric acid per day. There is a prospect that the hills of powdery sinter left as a byproduct from the roasting of the iron sulphide may eventually be used as iron ore.

The Vinegar Hill Zinc Co. is installing a ball mill which will have a capacity of about $6\frac{1}{2}$ tons per hour, and other milling equipment which will about double the present capacity. A Metals Reserve Co. stockpile of rough concentrate has already been accumulated and is growing daily in anticipation of opening the enlarged mill. A production of 3,500 tons per month of 60 percent zinc concentrate may well be realized in 1943.

Mine, Shop, and Plant

Valets for Workmen

MANPOWER conservation calls for maintenance of safety rules, including those pertaining to use of safety clothing. Such supplies will last longer if given ordinary intelligent care, whether they be of rubber, leather, asbestos, or flameproofed fabrics. How to do it has been broadcast recently by the MSA company.

Attention to proper cleaning and repair is the first important step. The larger the company the more important it will be to have this done at some central point.

Dry-cleaning for asbestos garments is preferred to ordinary laundering, as risk of shrinkage is lessened; this recommendation does not apply to asbestos gloves, however. Gloves should be inspected and sorted periodically, with unserviceable ones discarded, but those still serviceable should be saved for re-issuing whether they are pairs or odds. Enough odds for each hand will accumulate, that cannot be matched properly from the gloves returned for inspection. A quantity of rights or lefts to match those on hand can then be purchased.

Flameproofed garments are usually made of cottons that have been subjected to chemical solutions. These being solvent in water, it is necessary after laundering to re-flameproof the garment before returning it to service. Wool clothing should be dry-cleaned to prevent shrinkage. Leather goods are hard to clean. They should not, however, be washed; otherwise they will stiffen and shrink.

As to rubber gloves and clothing, present supplies must be conserved in every possible way. Rubber acid gloves, aprons, suits, etc., should be washed free of acids and alkalies after use, to increase their life. Oil or grease must not be allowed to come in contact with rubber materials. Rubber aprons and suits that get snagged in service should be repaired with inner-tube patches. Cold patches may prove satisfactory, but a regular vulcanizing patch is recommended.

Cold patches should never be put on rubber gloves used in handling acids. They may loosen. A good vulcanizing patch should be applied according to directions furnished with the patching material. Patches should be applied to both sides of the hole or tear, inside and outside the glove.

At the end of the work period, gloves should be washed thoroughly in cold water, left to dry, and the insides dusted with commercial talcum for ease in drawing them on. In storing rubber gloves after cleaning, they should be kept in a cool, dry place, without folding, and in a suitable carton for each separate pair.

In placing gloves on the hand, to prevent snags and tearing, the cuff should be turned back over the palm of the glove and the hand inserted. In this manner a double thickness of rubber is available for pulling on the glove.

Neoprene clothing should be used where there is oil or solvents. When garments or gloves of this material come in contact with heavy oils or greases, they should be cleaned with a solvent, rinsed, and hung up to dry. After gloves are dry they should be treated with talcum, and stored as recommended for rubber gloves.

Safety belts, in addition to careful regular inspection for safe condition, require attention as to cleanliness and proper storage.

Leather belts should be kept free from embedded dirt and should be dressed at intervals with neatsfoot oil, to preserve the flexibility. In cleaning them, first wipe off the surface dirt with a sponge or rag lightly dampened with warm water. Then rinse the rag or sponge in warm water and wring out until almost dry. With an alkali-free soap (castile or white toilet type), work up a thick lather, and wash the belt thoroughly to remove embedded dirt and perspiration deposits. When the belt is clean, wipe with a dry cloth to remove excess moisture.

While the belt is still damp, apply neatsfoot oil gradually and evenly with a clean wool rag, using not more than two teaspoonfuls. The oil should be worked into the leather evenly, using light, sweeping strokes. Allow the belt to remain in a dry, cool place for 24 hours, then wipe any surface oil from the leather with a soft cloth.

Leather belts should never be kept near steam-pipes, radiators, stoves or other heat sources. Excessive heat is harmful, and in extreme cases, where belts are laid against or hung on hot pipes or heaters to dry, the leather becomes hard and brittle at points of contact—ruined.

Life of cotton or linen fabric safety belts can be extended by regular soap-and-water cleaning. Cleaning is done as described for leather belts, except that a bristle brush may be used and water more liberally applied. When rinsed, the belt should be hung up to dry in freely circulating air.

Proper care of safety shoes includes attention to drying. Wet shoes never should be put on a stove or radiator, or near any source of heat. Heat hastens drying, but it draws out the oils from the leather, causes cracking, and materially shortens shoes' life. Shoes should be resoled before wear has proceeded beyond the first layer of sole leather. If the sole is permitted to be completely worn through, a satisfactory repair cannot be made. Metal foot guards often can be saved from the scrap pile by ordering and installing the replacement straps, springs, and parts required.

Maintaining the Vertical Turbine Pump

THE PUMP ITSELF—The pump[1] unit of a vertical turbine mine or mill pump consists of a multi-stage pump having a required number of impellers and pump bowls or casings (stages) assembled on the pump shaft. Impellers are spaced 4 to 12 in. or more apart, depending on size and capacity. Each is in a surrounding case or bowl of proportional length, either screwed or bolted together. These are fitted with a bearing on the shaft at center and support the directional vanes for guiding the water between impellers. On turbine pumps of the semi-open impeller type, the upper end of each bowl also forms the funnel-shaped impeller seat, while on the inclosed impeller type it forms the sealing ring for the impeller. As a result, this type of pump is efficient and sturdy, especially the semi-open unit, but there are limits as to the materials it will handle safely.

Abrasive and erosive materials, large gravel or sharp pieces of hard rock in particular, naturally will shorten pump life. In most jobs it is advisable to have a strainer with openings as small as conditions permit. The free area of openings of the strainer should be four to five times the suction pipe area. In cases where the pump will pick up grain- or pea-size particles, one must use a strainer or accept the resulting wear. Larger particles

[1] Third and concluding part of article by I. Alvin Oliver. Parts I and II appeared in April and May, respectively.

(size of peanuts or a ½-in. hexagonal nut), if allowed to go through the average turbine, will break, bend, or otherwise damage the impeller or guide vanes, and destroy pump performance. Most mine waters and some mill solutions are destructive to metallic parts, and the remedy lies in the use of appropriate metals or alloys.

The relative vertical position of the impeller in the bowls is controlled by the adjusting nut on the head shaft at the upper end of the motor assembly. Proper adjustment for each depth of pump setting is necessary if maximum performance and a useful life of the impellers and pump proper are to be attained. On inclosed impellers the adjustment should be made as follows:

1. Loosen adjusting nut until impellers drop down and touch bottom.

2. Tighten or screw on the adjusting nut, raising the weight of the moving parts, including the impellers, until these just barely clear the bottom and the parts can be rotated by hand.

3. From this point raise the impellers one complete turn of the adjusting nut and this will be the proper adjustment on a short, close-coupled pump.

4. On deep settings raise the impellers an additional one face of the hexagonal adjusting nut, or ⅛ turn, for every 20 ft. of depth of pump setting, plus one additional face for every 35

(*Concluded on page* 83)

Trouble Shooting With Motors

▶ THE *following paragraphs and the four motor-trouble-shooting charts that accompany them have been prepared by G. L. Abell, of the technical staff of Westinghouse Electric & Manufacturing Co., for E.&M.J. The convenient arrangement of the charts, facilitating reference, should make them useful wherever motors are used.*

MEN who are not experts in motor care are today being employed to care for electrical equipment that must give continuous operation. To assist them in their job, trouble-shooter charts of the more common "causes and cures" have been compiled in tabular form for rapid reference when motors fail to perform.

These charts are not the answer to all possible causes of trouble, but do cover most of the possible difficulties and their most likely causes. The facilities of the maintenance department may in cases limit the repairs that can be made. In other instances more adequate facilities may permit more extended repair than is suggested. In either case, repair men should check the listings against their experience and add to them if possible.

After a workman knows where his motors are situated and something about each application, he wants also to know what can happen to a motor or what to do when the cause or trouble is apparent. Misapplied motors can fail and leave the maintenance men baffled if their training does not help them to analyse and detect causes of failure. Intelligent maintenance aims at more than just repair. It also provides a system of improving the operation of machines, of taking care of their vital parts, of detecting troubles in the making, and specifies the steps to take for proper protection.

The conditions in which the motors must operate will often require special precautions for individual cases. However, should a motor be over-protected, over-heating may result. Tests should be made, inasmuch as shutdowns for repairs on important motors are costly and often can be avoided with proper attention.

Repair men must rely on their sense of hearing, feeling, and seeing to track down some causes of motor failures. Many things can be seen, such as moisture, oil, dust, excessive sparking, and burned insulation. Vibration, odd mechanical noises, brush chatter, and loose bearings can all be detected by hearing. Excessive heating can readily be identified with a touch of the hand. To these facilities add the information contained in the charts and it will not take many weeks of experience for the newcomer to electrical maintenance to become an asset to his company as a competent "trouble-shooter." (See pages 82 and 83 also)

Chart I—GENERAL GOOD MAINTENANCE PRACTICES

eep motor off line when not eded	This saves unnecessary wear of brushes, commutator, and bearings, saves lubrication	Reassembling of motor	Be sure to retain proper air gaps in motor by checking bore of pole faces before dismantling. Reassemble, replacing poles and liners in original position
o not leave field circuit excited less motor has been especially signed for this type of duty	Check temperature of shunt fields with thermometer to see that temperature does not exceed 90° C. When field must be excited, caution maintenance men to be sure field circuit is opened before working on the motor	Note wearing parts and parts frequently replaced to determine anticipated repairs	Carry in proper storeroom stock of parts. Make survey of standard repair parts to avoid duplication
eep motor clear of metal dust or ttings that can be drawn into ndings and pole pieces	Magnetic attraction will draw metal parts into air gap and damage windings		

Chart II—A.C., D.C. MOTOR TROUBLE CORRECTION CHECK CHART

TROUBLE	CAUSE	WHAT TO DO
ot bearings	Bent or sprung shaft	Straighten or replace shaft
	Excessive belt pull	Decrease belt tension
	Pulley too far away	Move pulley closer
	Pulley diameter too small	Use larger pulleys
	Misalignment	Correct by realignment of drive
eeve	Oil grooving in bearing obstructed by dirt	Remove bracket or pedestal with bearing and clean oil grooves and bearing housing; add new oil
	Bent or damaged oil rings	Repair or replace oil rings
	Oil too heavy	Use recommended lighter oil
	Oil too light	Use recommended heavier oil
	Insufficient lubricant	Fill reservoir to proper level in overflow plug with motor at rest
	Excessive end thrust	Reduce thrust induced by driven machine or supply external means to carry thrust
	Badly worn bearing	Replace bearing
all	Insufficient lubricant	Maintain proper quantity of grease in bearing
	Deterioration or contamination of lubricant	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease
	Excess lubricant	Reduce quantity. Bearing should be not more than half filled
	Heat from hot motor or external source	Protect bearing by reducing motor temperature
Ball—continued	Overloaded bearing	Check alignment, side thrust and end thrust
	Broken ball or rough races	Replace bearing; first clean housing thoroughly
Oil leakage from overflow plugs	Stem of overflow plug not tight	Remove, re-cement threads, replace and tighten
	Cracked or broken overflow fitting	Replace the plug
	Fitting cover not tight	Requires cork gasket, or if screw type, may be tightened
Hot motor	Ventilation blocked, end windings filled with fine dust or lint	Clean motor will run 10° to 30° C. cooler. Dismantle entire motor and clean all windings and parts
	Rotor winding clogged	Clean, grind and undercut commutator. Clean and treat windings with good insulating varnish
	Bearing and brackets coated inside	Dust and wash with cleaning solvent
Wet motor	Subject to dripping	Wipe motor and dry by circulating heated air through motor. Install drip- or canopy-type covers
	Drenched condition	Motor should be covered to retain heat and rotor position shifted frequently
	Submerged in flood waters	Dismantle and clean parts. Bake windings in oven at 105° C. for 24 hours or until resistance to ground is sufficient. First make sure commutator bushing is drained of water

Chart III—TROUBLE CORRECTION CHART FOR A C MOTORS

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Circuit open	Check connections
	One phase open	See that no phase is open
	Motor may be overloaded	Reduce load
	Rotor defective	Look for broken bars or rings
	Poor stator coil connection	Remove end bells, locate with test lamp
Motor does not come up to speed	Not applied properly	Consult supplier for proper type
	Voltage too low at motor terminals because of line drop	Use higher voltage on transformer terminals or reduce load
	If wound rotor, improper control operation of secondary resistance	Correct secondary control
	Starting load too high	Check load motor is supposed to carry at start
	Low pull-in torque of synchronous motor	Change rotor starting resistance or change rotor design
	Check that all brushes are riding on rings	Check secondary connections. Leave no leads poorly connected
	Broken rotor bars	Look for cracks near rings. A new rotor may be required as repairs are usually temporary
	Open primary circuit	Locate fault with testing device and repair
Motor runs and then slows down	Power failure	Check for loose connections to line, to fuses and to control
Motor stalls	Wrong application	Change type or size. Consult manufacturer
	Overloaded motor	Reduce load. Determine cause of overload and remove it.
	Low voltage	See that nameplate voltage is maintained
	Incorrect control resistance of wound rotor	Check control sequence. Replace broken resistors. Repair open circuits
Motor takes too long to accelerate	Excess loading	Reduce load
	Poor circuit	Check for high resistance
	Defective squirrel-cage rotor	Replace with new rotor
	Applied voltage too low	Get power company to increase voltage tap
Wrong rotation at start	Improper phase connection	Reverse connections at motor or starter
Motor overheats while running under load	Check for overload	Remove cause of overload
	Blowers or air shields, may be clogged with dirt and prevent proper ventilation	Good ventilation is manifested when continuous stream of air leaves motor. If not, check manufacturer
	Motor may have one phase open	Check to make sure all leads are well connected
	Grounded coil	Locate and repair
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers
	Shorted stator coil	Repair and then check wattmeter reading
	Faulty connection	Indicated by high resistance
	High voltage	Check terminals of motor with voltmeter
	Low voltage	
	Rotor rubs stator bore	If not poor machining, replace worn bearings
Motor vibrates after corrections have been made	Motor misaligned	Realign
	Weak foundations	Strengthen base
	Coupling out of balance	Balance coupling
	Driven equipment unbalanced	Rebalance driven equipment
	Defective ball bearing	Replace bearing
	Bearings not in line	Line up properly
	Balancing weights shifted	Rebalance rotor
	Wound rotor coils replaced	Rebalance rotor
	Polyphase motor running single phase	Check for open circuit
	Excessive end play	Adjust bearing or add washer
Unbalanced line current on polyphase motors during normal operation	Unequal terminal volts	Check leads and connections
	Single phase operation	Check for open contacts
	Poor contacts in resistance or other parts of rotor circuit	Check all connections and conductors in circuit
	Brushes not in proper contact with slip rings	See that brushes are properly seated and free in brushholders. Check shunts for good condition
Scraping noise	Fan rubbing air shield	Remove interference
	Fan striking insulation	Clear fan
	Loose on bedplate	Tighten holding bolts
Magnetic noise	Air gap not uniform	Check and correct bracket fits of bearing
	Loose bearings	Correct or renew
	Rotor unbalance	Rebalance

Chart IV—TROUBLE CORRECTION CHART FOR D.C. MOTORS

TROUBLE	CAUSE	WHAT TO DO
Fails to start	Circuit not complete	Switch open, leads broken
	Brushes not down on commutator	Held up by brush springs, need replacement. Brushes worn out
	Brushes stuck in holders	Remove and sand, clean up brush boxes
	Armature locked by frozen bearings in motor or main drive	Remove brackets and replace bearings or recondition old bearings if inspection makes possible
	Power may be off	Check line connections to starter with light. Check contacts in starter
Motor does not come up to rated speed	Overload	Check bearing to see if in first-class condition with correct lubrication. Check driven load for excessive load frequency
	Starting resistance not all out	Check starting to see if mechanically and electrically in correct condition
	Voltage low	Measure voltage with meter and check with motor name plate
	Short circuit in armature windings or between bars	For shorted armature inspect commutator for blackened bars and burned adjacent bars. Inspect windings for burned coils or wedges
	Starting heavy load with very weak field	Check full field relay and possibilities of full field setting of field rheostat
	Motor off neutral	Check for factory setting of brush rigging or test motor for true neutral setting
Motor gaining speed steadily and increasing load does not slow it down	Unstable speed load regulation	Inspect motor to see if off neutral. Check series field to determine shorted turns. If series field has a shunt around the series circuit that can be removed
	Reversed coil shunt or series	Test with compass and reconnect
	Too strong a commutating pole or pole air gap too small	Check with factory for recommended change in coils or gap
Motor runs too slow continuously	Voltage below rated	Measure voltage and try to correct to value on motor name plate
	Overload	Check bearings of motors and the drive to see if in first-class condition. Check for excessive friction in drive
	Neutral setting shifted	Check for factory setting of brush rigging or test for true neutral setting
	Armature has shorted coils or commutator bars	Remove armature to repair shop and put in first-class condition
Motor runs too fast	Voltage above rated	Correct voltage or get recommended change in air gap from manufacturer
	Shunt field coil shorted	Install new coil
	Shunt field coil reversed	Reconnect coil leads in reverse
	Series coil reversed	Reconnect coil leads in reverse
	Series field coil shorted	Install new or repaired coil
	Brush setting off neutral	Reset neutral by checking factory setting mark or testing for neutral
	Part of shunt-field rheostat shorted	Repair rheostat
	Motor ventilation restricted, causing hot shunt field	Hot field is high in resistance. Check causes for hot field. In order restore normal shunt field current
Motor overheats or runs hot	Overloaded and draws 25 to 50 percent more current than rated	Reduce load by changing gearing in the drive or reduce loading
	Voltage above rated	Motor runs drive above rated speed requiring excessive horsepower reduce voltage to nameplate rating
	Inadequately ventilated	Location of motor should be changed, or restricted surroundings removed. Covers used for protection are too restricting to ventilating air and should be modified or removed.

(Continued on opposite page, top left)

Chart IV—TROUBLE CORRECTION CHART FOR D.C. MOTORS—(Continued)

TROUBLE	CAUSE	WHAT TO DO
r overheats or hot (continued opposite page, om right)	Draws excessive current due to shorted coil. Grounds in armature such as two grounds which constitute a short	Repair armature coils or install new coil. Locate grounds and repair or rewind with new set of coils
	Armature rubs pole faces due to off center rotor causing friction and excessive current	Check brackets or pedestals to center rotor and determine condition of bearing wear for bearing replacement
) Hot armature	Core hot in one spot indicating shorted punchings and high iron loss	Sometimes full slot metal wedges have been used for balancing. These should be removed and other means of balancing be investigated
	Punchings uninsulated. Punchings have been turned or band grooves machined in the core. Machined slots	No load running of motor will indicate hot core and drawing high. No load armature current. Replace core and rewind armature. If necessary to add band grooves grind into core. Check temperature on core with thermometer not to exceed 90° C.
) Hot commutator	Brush tension too high	Limit pressure to 2 to 2½ psi. Check brush density and limit to that recommended by brush manufacturer
	Brushes off neutral	Reset brushes
	Brush grade too abrasive	Get recommendation from manufacturer
	Shorted bars	Investigate commutator mica and undercutting and repair
	Hot core and coils that transmit heat to commutator	Check temperature of commutator with thermometer to see total temperature does not exceed ambient plus 55° C. rise, total not to exceed 105° C.
	Inadequate ventilation	Check as for hot motor
e) Hot fields	Voltage too high	Check with meter and thermometer and correct voltage to nameplate value
	Shorted turns or grounded turns	Repair or replace with new coil
	Resistance of each coil not the same	Check each individual coil for equal resistance to be 10 percent and if one coil is too low replace coil
	Inadequate ventilation	Check as for hot motor
	Overheating deteriorates insulation and shortens life of the motor	
or vibrates and cates unbalance	Armature out of balance	Remove and statically balance or balance in dynamic balancing machine
	Misalignment	Realign
	Loose or eccentric pulley	Tighten pulley on shaft or correct eccentric pulley
	Belt or chain whip	Adjust belt tension
	Mismating of gear and pinion	Recut, realign, or replace parts
	Unbalance in coupling	Rebalance coupling
	Bent shaft	Replace or straighten shaft
	Foundation inadequate	Stiffen mounting place members
	Motor loosely mounted	Tighten holding down bolts
	Motor feet uneven	Add shims under foot pads to mount each foot tight
or sparks at shes or does not mutate	Brushes off neutral	Check and set on factory setting or test for true neutral
	Commutator rough	Grind and roll edge of each bar
	Commutator eccentric	Turn and grind commutator
	Mica high	Undercut mica
	Commutating pole strength too great causing over-compensation or strength too weak indicating under-compensation	Check with manufacturer for correct change in air gap or new coils for commutating coils
	Shorted commutating pole turns	Repairs coils or install new coils
	Shorted armature coils on commutator bars	Repair armature by putting into first-class condition
	Open circuited coils	Same as above
	Poor soldered connected to commutator bars	Resolder with proper alloy of tin solder
	High bar or loose bar in commutator at high speeds	Inspect commutator, tighten, turn and grind
	Brush grade wrong type. Brush pressure, too light. Current density excessive. Brushes stuck in holders. Brushes shunt loose	See Brushes
	Brushes chatter due to dirty film on commutator	Resurface commutator face and check for change in brushes
	Vibration	Eliminate cause of vibration by checking mounting and balance of rotor
Brush wear excessive	Brushes too soft	Blow dust from motor and replace brushes with changed grade recommended by manufacturer
	Commutator rough	Grind commutator face
	Abrasive dust in ventilating air	Reface brushes and correct condition by protecting motor
	Off neutral setting	Recheck factory neutral or test for true neutral
	Bad commutation	See corrections for commutation
	High, low or loose bar	Retighten commutator motor bolts and resurface commutator
	Brush tension excessive	Adjust spring pressure not to exceed 2 lb. psi.
	Electrical wear due to loss of film on commutator face	Resurface brush faces and commutator face
	Threading and grooving	Same as above
	Oil or grease from atmosphere or bearings	Correct oil condition and surface brush faces and commutator
	Weak acid and moisture-laden atmosphere	Protect motor by changing ventilating air, or change to inclosed motor
Motor noisy	Brush singing	Check brush angle and commutator coating, resurface commutator
	Brush chatter	Resurface commutator and brush face
	Motor loosely mounted	Tighten foundation bolts
	Foundation hollow and acts as sounding board	Coat underside with soundproofing material
	Strained frame	Shim motor feet for equal mounting
	Armature punchings loose	Replace core on armature
	Armature rubs pole faces	Recenter by replacing bearings or relocating brackets or pedestals
	Magnetic hum	Refer to manufacturer
	Belt slap or pounding	Check condition of belt and change belt tension
	Excessive current load	May not cause overheating but check chart for correction of short or ground and coils
	Mechanical vibration	Check chart for causes of vibration
	Noisy bearings	Check alignment, loading of bearings, lubrication and get manufacturer's recommendation

The Turbine Pump

(*Continued from page* 81)

ft. of pressure head above elevation of pump head.

On semi-open impellers the adjustment should be as follows:

1. Loosen adjusting nut until impellers are lowered and touch bottom.

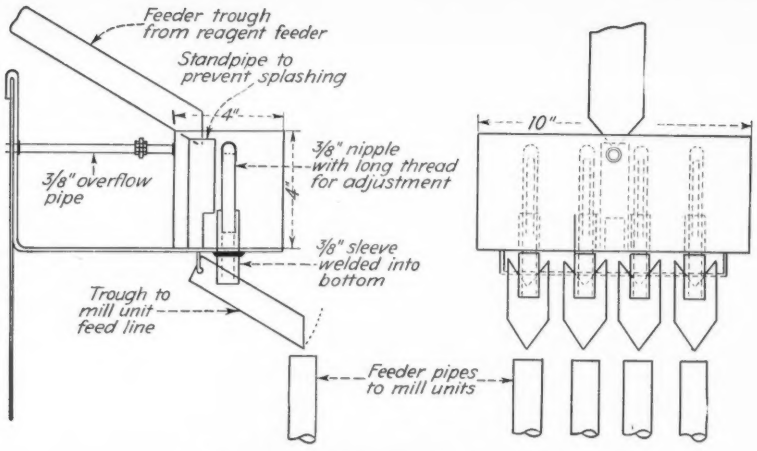
2. Tighten down or screw on adjusting nut, raising weight of moving parts, including impellers, until these just barely clear the bottom.

3. From this point raise impellers two hexagonal faces, or ⅓ turn of the adjusting nut.

4. On deep settings raise impeller one face, or ⅛ turn of adjusting nut, for every 25 ft. of length of drive shaft, plus one additional ⅛ turn for every 40 ft. of pressure head above elevation of pump head.

These instructions should be followed carefully. It is important to operate impellers with proper clearance. The hydraulic load always stretches the drive shaft after the impellers are operating on full load, and allowance must be made by raising the impellers according to shaft length and head above to prevent them from rubbing on the bottom and ruining the pump. Proper lubrication of drive shaft and pump bearings is important. On the inclosed oil-tube drive shaft construction, the oiling usually is by adjustable automatic drip. In instances, oil of the quality used in the head bearings is in the drip feed oiler, but this is not always necessary. As drip oiling requires much oil, a cheaper grade may be used. However, it is well to have the manufacturer's advice as to oils and greases to be used. On the water-lubricated, open-drive-shaft turbine pumps no oil is required below the pump head. However, all water-lubricated pumps must be prelubricated before starting by running from 10 to 50 gal. of water down the discharge column to wet the bearings.

Useful Operating Ideas


Feeder trough from reagent feeder
Standpipe to prevent splashing
4"
10"
3/8" nipple with long thread for adjustment
3/8" overflow pipe
3/8" sleeve welded into bottom
Trough to mill unit feed line
Feeder pipes to mill units

Liquid Reagent Distributor

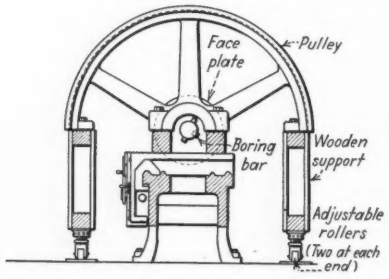
LIQUID REAGENTS, particularly in non-metallic flotation work, must often be fed to a mill circuit at several closely spaced points, and it may be impossible to measure and control accurately the reagent flow without use of elaborate or expensive equipment. A simple method of accomplishing this distribution from one master reagent feeder is suggested by George C. Bush, mill superintendent of Imperial Metals, Inc., Darwin, Calif.

The unit consists of a receiver of convenient size fitted with $\frac{3}{8}$-in. pipe sleeves welded or brazed through the bottom, the number of sleeves corresponding to the number of points to receive the reagent. This receiver is kept full of reagent by a siphon or other automatic device, and an overflow pipe returns excess reagent to the main supply. A $\frac{3}{8}$-in. nipple is inserted into each sleeve, the length of the nipple being such as to allow some range of adjustment vertically. Flow of reagent through each pipe can thereafter be regulated closely by setting the height of the nipples. Hinged troughs below the receiver tank permit the operator to measure the flow from each pipe. Details are shown in the accompanying sketch.

It is advisable, Mr. Bush found, to have the threads on the regulators machined rather than cut with pipe threaders, because smoother and more stable adjustments can thereby be obtained.

Reboring a Large Pulley In a Lathe

THE MECHANICAL DEPARTMENT at a large gold-silver mine in central Mexico was recently confronted with the task of providing a motor-driven air compressor with a larger drive pulley. The pulley available had the right size diameter, but the bore was too small to accommodate the compressor shaft. To utilize it meant a reboring job. Unfortunately, the shop was not equipped with a lathe large enough to handle the pulley, and press of time made it impossible to ship the pulley to a factory in Mexico City. The problem was successfully solved in the following manner: Two wooden benches or supports were made and placed one on each side of a conventional lathe, each support being fitted with two adjustable rollers. Half of the pulley was set with the hub on the carriage of the lathe, and one end of the face on each of the supports. The half pulley was then centered and the bore enlarged to proper size with a boring bar, the rollers on the supports allowing the entire set-up to travel with the lathe carriage. The arrangement is shown in detail in the accompanying sketch.



After reboring operations had been completed, the second half of the pulley was swung over it with chain blocks, and the two halves were bolted together. Next, the proper centers were determined and the cut was outlined and marked. The marked half of the pulley was then placed in the lathe, centered in accordance with the marking, and bored in the same way as the first half. The job was done in record time, and the pulley ran true on the compressor shaft.

Five Dollars for an "Idea"

SHORTAGE OF EQUIPMENT in the present emergency puts a premium on the ingenuity of master mechanics and electricians to keeping mining and milling machinery running. If you have done an interesting job, just sketch or photograph it and send it in with a brief description. *E.&M.J.* will pay $5 for acceptable items.

Jackhammer Serves As Concrete Vibrator

ENGINEERS are all agreed, says P. C. Ziemke, of Milwaukee, Wis., that best results are obtained in concrete pouring only when a thorough job of vibrating or "puddling" is done properly to compact and solidify the mass, to drive off excess water, and to eliminate voids that disfigure the work after form stripping. Hand puddling will do well enough for the small jobs involving simple and shallow forms, but some sort of machine vibrating is required for all large jobs.

Having no such machine available when caissons were built to sink a shaft through quicksand, Mr. Ziemke improvised one from a jackhammer drill secured from a nearby tool shed. An old 2-ft. section of drill steel was used for the shank by cutting off approximately one half of the bit with a torch. This cut was dressed off on the power wheel to prepare a good surface for attaching, by welding, a circular plate 10 in. in diameter and $\frac{5}{16}$ in. thick.

When first tried out, the vibrator functioned satisfactorily with this exception: the plate rotated as the drill had done formerly. However, after the machine had been dismantled and the pawl from the rotating mechanism removed, the reassembled vibrator functioned effectively all during the time concreting was in progress.

Reflections From Washington

(*Continued from page* 55)

acted upon more efficiently at the Washington office."

Up to the time of writing, no SWPC funds had been loaned to mines, and in view of the record the prospects are remote. When SWPC was set up by Congress in June, 1942, one of the purposes of the organization was to render financial assistance to small concerns to enable them to increase production of raw materials essential to the war effort. A fund of $150,000,000 was set up in the act for the purpose. Paragraph (f) Sec. 2. reads in part as follows: "The Corporation is empowered (1) to make loans or advances, on such terms and conditions and with such maturities as it may determine, to enable small business concerns to finance plant construction, conversion, or expansion, or to finance the acquisition of equipment, facilities, machinery, supplies, or materials, or to supply such concerns with capital, to be used in the manufacture of articles, equipment supplies, or materials for war or essential civilian purposes; and such loans or advances may be made or effected either directly or in cooperation with banks or other lending institutions through agreements to participate or by the purchase of participations, or otherwise." Much less than 10 percent of the $150,000,000 fund had been loaned by June 1, 1943. Further, up to that time, no fixed policy had been established by SWPC for making mining loans. The Corporation will, however, consider applications which are certified by another government agency. Washington mining officials doubt if the SWPC declaration of intention to make mining loans has any immediate meaning for the industry. Probably the move reflects the desire of politicians to satisfy those constituents whose proposals have not been able to pass muster under the scrutiny of RFC engineers and the wish of certain bureaucrats to make a WPA of the mining industry with a view to their getting control of it.

Meat for Miners

AFTER MUCH PRODDING by senators and congressmen and the mining industry itself, OPA finally came out with the long awaited plan to give miners a supplemental ration of meats and fats. Miners, loggers, prospectors, and others, regardless of occupation, who live where they cannot readily secure unrationed protein foods may apply to their local ration boards for a supplemental allotment. The extra ration will be given if fish, poultry, and eggs are not available. Temporary local shortages that currently exist in the supplies of poultry in some sections of the country will not be the basis for granting requests for extra allowances.

Local ration boards have been instructed that the maximum extra amount they are permitted to authorize is 1.8 points per person per day. "The amount granted will be based on need, rather than desire, and OPA offices will allow less than 1.8 points if limited amounts of fresh fish, poultry and eggs are available to the applicant." Certificates rather than stamps will be issued to cover the additional allotments.

Individuals as well as logging camps, mines, fishing boats, and similar businesses where the employees are fed in connection with their occupation are eligible. Under the plan an additional 2 to 3 lb. of meat per week per man may be made available, depending on the value of the points in pounds of meat.

One catch in the new OPA orders is that it is left up to the local board to determine whether the applicants for relief "live or work far from population centers and therefore cannot meet their nutritional needs by supplementing their meat-fat rations with fresh fish, poultry, and eggs." There is no definition of how far is far. Interpretations may differ widely. Another point that may cause difficulty is that local boards must be authorized by the regional office to rule on applications. If there has been no authorization, the local board sends the papers into the regional office, where decision is made on the action to be taken. The papers are then returned to the local board. It appears that the situation is wide open for delay, confusion, and a lack of uniform action in the various mining areas.

Timber Price Ceilings

THE REVISED CEILINGS set by OPA over mine ties and timbers on peeled pit posts and extra length pit posts, mine caps, and switches will make it easier for operators to purchase these items. Before the upward revision of the ceiling, the prices were so low that these timbers were not produced by the mills. The mining industry had to buy similar material under a different name and cut for another industry with a higher ceiling in order to get supplies. The only change that mine operators can hope for is that the supply of timbers will be a little more plentiful because of the price revision, but in view of the labor shortage in the lumber industry it is doubtful that this desirable result will be achieved.

Reciprocal Trade Renewal

THE POSITION of the American Mining Congress on the extension of the reciprocal trade agreements was explained by Julian D. Conover, secretary, at the hearings on the act before the Senate Finance Committee, May 19. Stating that the operation of the act over the past nine years had been detrimental to the mining industry, Mr. Conover explained that if the act was extended it should be amended "in the following particulars:

"1. Congress, representing the people, should review and pass upon all trade agreements before they become effective.

"2. The law should specifically provide that our negotiators may make tariff concessions on any commodity only to that country which constitutes the principal source of imports.

"3. There should be definite provisions in the law making mandatory the application of the 'escape clauses,' and providing for adequate review and correction of injury to domestic producers."

The reciprocal trade treaty renewal bill had been passed by the House with no restrictive amendments except that the term of the bill was reduced from three to two years. In the Senate Finance Committee, the Administration received a serious setback when the committee adopted an amendment that would permit Congress to terminate agreements six months after the end of the war by joint resolution. In this form the bill was reported to the Senate floor, where it was the principal subject of consideration from May 24 to June 2. During the last days of the debate several amendments were offered involving ratification, but all were finally beaten down. The Senate removed the committee amendment and passed the bill as sent from the House. This reversal of an important committee's considered action undoubtedly reflected hectic backstage political horse-trading.

Release of Treasury Silver

JUNE may be the month in which the amended Green bill becomes a law. It would authorize the Treasury to sell silver at 71.11c. per ounce instead of $1.29, the present legally fixed selling price for domestic silver. The bill would make immobilized Treasury silver available for industrial use by permitting Treasury silver certificates to be backed by silver in the form of busbars or other non-deteriorable industrial forms instead of bullion. Britain is taking all of Canada's output and Mexico has curtailed her exports because she must make coins for her-

(*Continued on page* 130)

Summary of the MARKETS

DOMESTIC PRODUCERS of chrome ore, manganese ore, beryllium ore, and tantalite will receive higher prices as a result of a revision in the purchasing schedules of the Metal Reserve Co. In reference to chrome and manganese ores, the penalties were eased sufficiently to benefit virtually all producers. The buying program for quicksilver was extended last month by MRC to Dec. 31, 1944, which, in effect, will permit domestic producers to plan ahead under the prevailing level of prices and thereby maintain output at a high rate. The mica schedule was revised to further encourage production of strategic grades. Iridium was placed under full allocation by WPB.

So far as the major metals were concerned, the situation pricewise did not change. Copper scrap is being used more extensively in some directions, and the tonnage of primary metal allocated for June was not up to the peak of earlier months this year. The industry believes that a fair tonnage will go into stockpile.

UNITED STATES MARKET

1943	Electrolytic Copper		Straits Tin	Lead		Zinc
	Domestic	Export	New	New	St. Louis	St. Louis
May	(a) Refinery	(b) Refinery	York	York		
1	11.775	11.700	52.000	6.50	6.35	8.25
3	11.775	11.700	52.000	6.50	6.35	8.25
4	11.775	11.700	52.000	6.50	6.35	8.25
5	11.775	11.700	52.000	6.50	6.35	8.25
6	11.775	11.700	52.000	6.50	6.35	8.25
7	11.775	11.700	52.000	6.50	6.35	8.25
8	11.775	11.700	52.000	6.50	6.35	8.25
10	11.775	11.700	52.000	6.50	6.35	8.25
11	11.775	11.700	52.000	6.50	6.35	8.25
12	11.775	11.700	52.000	6.50	6.35	8.25
13	11.775	11.700	52.000	6.50	6.35	8.25
14	11.775	11.700	52.000	6.50	6.35	8.25
15	11.775	11.700	52.000	6.50	6.35	8.25
17	11.775	11.700	52.000	6.50	6.35	8.25
18	11.775	11.700	52.000	6.50	6.35	8.25
19	11.775	11.700	52.000	6.50	6.35	8.25
20	11.775	11.700	52.000	6.50	6.35	8.25
21	11.775	11.700	52.000	6.50	6.35	8.25
22	11.775	11.700	52.000	6.50	6.35	8.25
24	11.775	11.700	52.000	6.50	6.35	8.25
25	11.775	11.700	52.000	6.50	6.35	8.25
26	11.775	11.700	52.000	6.50	6.35	8.25
27	11.775	11.700	52.000	6.50	6.35	8.25
28	11.775	11.700	52.000	6.50	6.35	8.25
29	11.775	11.700	52.000	6.50	6.35	8.25
31	Holiday	11.700	Holiday	Holiday	Holiday	Holiday
			AVERAGE FOR MONTH			
May	11.775	11.700	52.000	6.50	6.35	8.25
May			AVERAGES FOR WEEK			
5	11.775	11.700	52.000	6.50	6.35	8.25
12	11.775	11.700	52.000	6.50	6.35	8.25
19	11.775	11.700	52.000	6.50	6.35	8.25
26	11.775	11.700	52.000	6.50	6.35	8.25
May			CALENDAR WEEK AVERAGES			
1	11.775	11.700	52.000	6.50	6.35	8.25
8	11.775	11.700	52.000	6.50	6.35	8.25
15	11.775	11.700	52.000	6.50	6.35	8.25
22	11.775	11.700	52.000	6.50	6.35	8.25
29	11.775	11.700	52.000	6.50	6.35	8.25

SILVER, GOLD AND STERLING EXCHANGE

1943	Sterling Exchange		Silver		Gold	
	"Checks"	"90-day	(c)			(d) United
May	(Nominal)	demand"	New York	London	London	States
1	401.000	(f)	(e)	(e)	(e)	$35.00
3	401.000	(f)	44.750	23.500	168s	35.00
4	401.000	(f)	44.750	23.500	168s	35.00
5	401.000	(f)	44.750	23.500	168s	35.00
6	401.000	(f)	44.750	23.500	168s	35.00
7	401.000	(f)	44.750	23.500	168s	35.00
8	401.000	(f)	(e)	(e)	(e)	35.00
10	401.000	(f)	44.750	23.500	168s	35.00
11	401.000	(f)	44.750	23.500	168s	35.00
12	401.000	(f)	44.750	23.500	168s	35.00
13	401.000	(f)	44.750	23.500	168s	35.00
14	401.000	(f)	44.750	23.500	168s	35.00
15	401.000	(f)	(e)	(e)	(e)	35.00
17	401.000	(f)	44.750	23.500	168s	35.00
18	401.000	(f)	44.750	23.500	168s	35.00
19	401.000	(f)	44.750	23.500	168s	35.00
20	401.000	(f)	44.750	23.500	168s	35.00
21	401.000	(f)	44.750	23.500	168s	35.00
22	401.000	(f)	(e)	(e)	(e)	35.00
24	401.000	(f)	44.750	23.500	168s	35.00
25	401.000	(f)	44.750	23.500	168s	35.00
26	401.000	(f)	44.750	23.500	168s	35.00
27	401.000	(f)	44.750	23.500	168s	35.00
28	401.000	(f)	44.750	23.500	168s	35.00
29	401.000	(f)	(e)	(e)	(e)	35.00
31	Holiday	(f)	Holiday	23.500	168s	35.00
			AVERAGE FOR MONTH			
May	401.000 nom.	....	44.750	23.500	....	35.00
May			AVERAGES FOR WEEK			
5	401.000	.....	44.750	.....	....	.....
12	401.000	.....	44.750	.....	....	.....
19	401.000	.....	44.750	.....	....	.....
26	401.000	.....	44.750	.....	....	.....

Calendar week averages, New York Silver: May 1st, 44.750; 8th, 44.750; 15th, 44.750; 22nd, 44.750; 29th, 44.750.
(e) Not quoted (Saturday). (f) No quotation.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the World War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. We deduct .05c. from the f.a.s. basis (lighterage, etc.) to arrive at the f.o.b. refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c. per troy ounce. Handy & Harman's quotations on newly-mined domestic silver, 999 fine was 70⅝c. throughout May.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.925.

The Bureau of Mines revealed that mine output of copper in the United States during 1942 imounted to about 1,072,000 tons, an increase of 12 percent over 1941.

The conservation order for lead was eased slightly during May. Domestic consumption of lead has been holding at a steady rate of about 65,000 tons a month. Mexico has ordered that all exports of minerals excepting gold and silver be licensed. This action will have no bearing on the movement of lead and other metals from Mexico to the United States, producers contend.

Flood conditions in the Tr-State district cut into zinc concentrate production, but output of metal was maintained and the over-all picture in zinc did not change.

Renegotiation of Bolivian tin ore contracts with Metals Reserve is expected to lift the price of tin contained to 70c. a pound, South American ports, an advance of 10c. Even should this revision come about, the price at which consumers obtain tin is not expected to change.

MONTHLY AVERAGES

Monthly averages for copper, lead, zinc, tin, silver (New York and London), gold, and sterling exchange appear on preceding page. Average prices of miscellaneous metals for February and March follow:

	April	May
Quicksilver, N. Y. flask	196.000	196.000
Antimony (a)	16.049	16.049
Antimony, bulk, Laredo	14.500	14.500
Antimony, bulk, N. Y.	15.509	15.479
Antimony, Chinese (b)	16.500	16.500
Platinum, oz. troy	35.000	35.000
Cadmium (c)	90.000	90.000
Cadmium (d)	92.500	92.500
Cadmium (e)	95.000	95.000
Aluminum, ingot	15.000	15.000
Magnesium, ingot	20,500	20,500

(a) New York, packed in cases, in lots of 5 tons or more but less than a carload. (b) Nominal. (c) Producer's price for commercial sticks. (d) Average of producer's and plater's quotations. (e) Special shapes sold to platers.

E & M J PRICE INDEX

Weighted index of non-ferrous metal prices (copper, lead, zinc, tin, silver, nickel, and aluminum). The average for the years 1922-1923-1924 equals 100.

1929	110.33	1936	73.45
1930	82.87	1937	90.86
1931	60.20	1938	73.67
1932	48.26	1939	77.71
1933	59.79	1940	79.22
1934	69.59	1941	83.49
1935	74.66	1942	86.80

	1941	1942	1943
January	82.48	85.39	88.74
February	82.76	85.90	88.74
March	83.27	85.90	88.74
April	83.48	85.90	88.74
May	83.51	85.90	88.74
June	83.48	85.90	....
July	83.60	85.90	....
August	83.39	85.90	....
September	83.34	88.74	....
October	83.84	88.74	....
November	84.32	88.74	....
December	84.42	88.74	....

CURRENT PRICES—MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(June 1, 1943)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	15c.
Antimony, domestic, spot, lb. 5 tons or more	16.049c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	90c.
Calcium, lb., ton lots 97 @ 98 per cent	$1.25
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	20½c.
Palladium, troy os	$24.00
Platinum, (Official quotation) troy os	$35.00
Quicksilver, flask of 76 lb., 100 flasks or more	$196.00@$198.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, carloads lb	14.75c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$10.00
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, 10 to 12% BeO. f.o.b. mines, ton	(b) $100.00@$120.00
Chrome Ore, per long ton, f.o.b. cars Atl. ports, dry, 48% Cr_2O_3, 2.8 to 1 ratio	$41.00
48% Cr_2O_3, 3 to 1 ratio	$43.50
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$76.54
Manganese (dutiable) f.o.b. cars Atl. ports, long ton unit Mn:	
50 per cent	79.8c.
48 per cent	78.8c.
46½ per cent	76.8c.
Manganese Ore, domestic, 48%, f.o.b. MRC depot, l.t. unit	$1.00
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	(b) $24.00
Domestic, 65 per cent and upward	(a) $26.00
Vanadium Ore, per lb. of contained V_2O_5 f.o.b. mines	27.50c
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo; per ton	$55.28

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	4c.
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$5.00

ALLOYS

Beryllium Copper, 2.5 to 3 percent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 percent per pound of Cr contained	13c.
Ferromanganese, 78 @ 82 per cent, gross ton	$135.00
Ferromolybdenum 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 per cent, gross ton	$74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90
Ferrovanadium, per lb. of V, delivered	$2.70@$2.90
Silicomanganese, 1½ per cent C, gross ton	$135.00

NON-METALLIC MINERALS

Asbestos, f.o.b. Canadian (Quebec) mines (U. S. funds), ton:	
Crude No. 1	$650@$750
Crude No .2	$165@$385
Spinning fibers	$124@$733
Paper stock	$44@$49.50
Shorts	$14.50@$26.50
Vermont, f.o.b. Hyde Park:	
Shingle stock	$62.50@$65.00
Paper stock	$44.00@$53.00
Shorts	$14.50@$28.50
Floats	$19.50
Barytes, long ton:	
Georgia, crude	$8.50@9.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$6.75@$7.25
Bauxite, long ton:	
Domestic, crude, 50 @ 52 per cent (not dried)	$5.00
Domestic, chemical, 55 @ 58 per cent	$7.50@$8.50
Domestic, abrasive, 80 @ 84 per cent	$16.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$15.00
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$28.00
Ground, 95 @ 98 per cent, bulk, ton	$34.00
Acid, 98 and 1 per cent, bulk, ton	$35.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton dead-burned, f.o.b. Washington	$22.00

Mica—Base prices on sheet, North Carolina one-half trim, as posted by the Colonial Mica Corp., the Government's buying agency for obtaining strategic mica, per pound, follow: Sheet to cut minimum of 1½ × 2 in. $2.40; 2 × 2 in. $3.52; 2 × 3 in. $4.64; 3 × 3 in. $5.12; 3 × 4 in. $6.08; 3 × 5 in. $7.04; 4 × 6 in. $8.00; 6 × 8 in. $9.12; punch, 30c. Premium and discounts up to 40 percent, depending on quality and trim. Scale does not apply to non-strategic mica.

Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	12c., nom.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
Vermont, extra white, 200 mesh	$9.50@$10.50
Tripoli Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton: Basic	$23.50
Steel, base prices, Pittsburgh Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10

Personal Items

F. S. Hogan has joined the U. S. Bureau of Mines branch at Bay City, Mich.

Dr. J. B. Tyrrell has been made an honorary member of the Royal Canadian Institute.

A. R. Krefting, mining engineer with the Cerro de Pasco Copper Corp. in Peru, is in the United States.

Douglas B. Sterrett, a mining engineer formerly living in Kamloops, B. C., has removed to Amelia, Va.

Alvin M. Cummings, mining engineer, has joined the staff of the U. S. Bureau of Mines at Rapid City, S. D.

William M. Nilly has returned to the United States, having completed a three-year contract as a mining engineer with Braden Copper Co. in Chile.

Russell J. Parker, mining engineer of New York and recently on the staff of Kennecott Copper Corp., has gone to South America.

Richard H. Reece has been appointed president of the New Mexico School of Mines and Director of the State Bureau of Mines and Mineral Resources.

A. G. Langley, well known Vancouver mining engineer, has been honored with a life membership in the Canadian Institute of Mining and Metallurgy.

S. B. Dickenson, deputy director of mines in South Australia, has been granted the degree of Master of Science by the University of Melbourne.

Charles E. Marr, president of Sheep Creek Gold Mines, Ltd., has been elected a director of the Old National Bank of Spokane.

Lieut. John Lamb, recently on the staff of the Cariboo Gold Quartz Mining Co., Ltd., is overseas with the Royal Canadian Engineers.

George Griffith has become a mine foreman for Zincton Mines, Ltd., at Zincton, B. C. He was formerly on the staff of Bralorne Mines, Ltd., at Bralorne, B. C.

R. E. Kelly, Phelps Dodge Corp., Ajo, Ariz., has received honorable mention from War Production Drive headquarters of WPB for suggesting an improvement in feeding balls into ball mills.

Charles King, late of the Polaris-Taku Gold, Pioneer Gold, and Granby Consolidated concentrator staffs, has been engaged by the Dominion Government's Kootenay Florence Project.

Lloyd C. White, until recently assistant chief engineer for Manganese Ore Co. at Las Vegas, Nev., has returned to his headquarters at 1005 Oxford St., Berkeley, Calif.

Herbert A. Sawin has been elected chairman of the San Francisco Section of A.I.M.E., **H. W. Gould** is vice chairman, and **Gordon I. Gould** continues as secretary-treasurer.

R. C. Gebhardt, geologist, has joined the Alaska Pacific Mining Co. at Wasilla, Alaska, which is operating in the Willow Creek gold area, on the Alaska Railway.

C. C. Camp, formerly associated with the Privateer gold mine, at Zeballos, B. C., has become assistant to the development engineer of Butler Bros., at St. Paul, Minn.

Alfred N. Miller, mining engineer, has resigned as assistant to the chief engineer of Canadian Allis-Chalmers Co. and joined the staff of the Aluminum Co. of Canada, at its head office in Sun Life Building, Montreal, Quebec.

R. O. Camozzi, recently with the mine-operating department of Newmont Mining Corp., has been made manager of the corporation's New Verde Quicksilver mine, in Elko County, Nev.

W. G. Swart, of Alameda, Calif., formerly of Duluth, Minn., when he was vice president and general manager of the Mesabi Iron Co., fell in his home recently and suffered a broken leg. He is recuperating in an Alameda hospital.

Philip B. Freeland, chief mining engineer of British Columbia Department of Mines, was superannuated on April 1 last. He has been succeeded by **Hartley Sargent,** formerly resident mining engineer at Vancouver, B. C.

Walter Lyons, of Ironwood, Mich., associated with Pickands, Mather & Co., is in charge of sinking a ventilation bore shaft at Hurley, Wis. **J. B. Newsom,** until recently engaged in that work, has gone to California.

MacLeod White has become assistant general manager of Yukon Consolidated Gold Corp., Ltd., at Dawson, Y. T. He was formerly with Consolidated Mining & Smelting Co. in the Atlin district of British Columbia.

F. C. Stanford, electrical engineer for the Cleveland-Cliffs Iron Co. since 1910, was retired on May 1 and will make his future home at St. Joe, Mich. He will be succeeded by **E. D. Cory,** formerly of Pittsburgh, Pa.

Fred O. Davis has been elected president of the New Mexico Miners and Prospectors Association. Mr. Davis has long been identified with mining and prospecting in New Mexico, and since 1935 has been associated with the Potash Co. of America.

Robert D. Fisher has been elected secretary of Cleveland-Cliffs Iron Co. and also of Cliffs Corp. Mr. Fisher is vice president, secretary, and office counsel of Western Reserve University, at Cleveland, Ohio.

Clark Henry, a former well-known mine superintendent on the Mesabi range, has returned to the United States from Kodiak, Alaska, where for the last two years he has been supervising construction work.

Andrew Thickstun, consulting mining engineer, Fresno, Calif., has been appointed agent of Metals Reserve Co. for the purchase of tungsten concentrates.

W. S. Baxter, mining engineer for Montreal Mining Co., at Montreal, Wis., has been promoted to chief engineer of the Castile Mining Co., at Ramsey, Mich.

L. L. Bolton will represent the Canadian Institute of Mining and Metallurgy on the main committee of Canadian Engineering Standards Association from April 1, 1943, to March 31, 1946.

Harry Hey, who has occupied the position of chief metallurgist of the Electrolytic Zinc Company of Australasia Ltd. for many years, has been appointed assistant superintendent. He has recently returned from a visit to the United States, Canada and England.

David Meredith, who recently resigned the position of general superintendent of the Electrolytic Zinc Company of Australia Ltd., has been appointed business administrator in Tasmania for the Ministry of Munitions.

K. T. Cunningham, previously assistant mill superintendent of Mount Isa Mines Ltd., Queensland, has been appointed mill superintendent in succession to **L. K. Jacobson,** who has returned to the United States.

James Douglas, formerly chief of the Metals Section of the Mining Equipment Division, WPB, has been appointed director of the Zinc Division, succeeding **George C. Heikes,** who resigned recently to join the staff of the Olin Corp., Tacoma, Wash.

H. E. Son has been elected president of the Hegeler Zinc Co., Danville, Ill., succeeding the late **Julius Hegeler.** He has been associated with the company since July, 1918. **C. E. Kiningham** has been named vice-president, and **M. E. Thompson** secretary-treasurer.

Dr. H. Clare Horwood, of the Ontario Department of Mines, has been appointed resident geologist for northwestern Ontario, with headquarters at Port Arthur. He will assume his new duties immediately.

Leon Henderson, former Price Administrator, has accepted the post of chairman of the board of editors of the Research Institute of America, a private organization founded in New York in 1935 to furnish business information to manufacturers.

L. G. Blakemore, mining engineer, formerly of San Francisco, now opening a silver-lead prospect near Nelson, Nev., has been sampling zinc-lead claims in the Galena district, 13 miles south of Reno, for Pacific Coast clients.

A. E. Place, engineer in charge of the productive Wall Street mine, in Eldorado Canyon near Nelson, Clark County, Nev., until closed down by the WPB order, is now with the U. S. Bureau of Mines at the Boulder City, Nev., metallurgical plant.

Paul F. Armstrong, Montreal consulting geologist and mining engineer, has joined the staff of the U. S. Board of Economic Warfare. He is stationed in Brazil, where his address will be U. S.

Purchasing Commission, 165 Avenida del Presidente Wilson, Rio de Janeiro.

L. N. Wenerstrom has joined the staff of Tamarack & Custer Consolidated Mining Co. at Wallace, Idaho, as metallurgist. He was formerly for a long period associated with the Granby Consolidated Mining, Smelting & Power Co., Ltd., at Copper Mountain, B. C.

Jay A. Carpenter, director of the Nevada State Bureau of Mines, has been at Goodsprings, where federal aid is being afforded to zinc miners, and visited the plants of the Basic Magnesium Inc. and Manganese Ore Co. near Las Vegas in his capacity of advisory engineer in Nevada for Metals Reserve Co.

Dr. J. T. Mandy, for the past fifteen years resident mining engineer at Prince Rupert for the British Columbia Department of Mines, has been transferred in the same capacity to Vancouver, where he will succeed **Dr. Hartley Sargent,** who has been elevated to the office of chief mining engineer of the department.

Earl Ver Bunker, mining engineer with Montreal Mining Co., at Montreal, Wis., after taking a year's absence, during which period he was engaged with the Arthur G. McKee organization, of Cleveland, Ohio, in building an ore-treatment plant at Jacksonville, Tex., has returned to his post at Montreal.

Ezra E. Erich, who for the past year has been supervisor engineer for the Reconstruction Finance Corporation mining division in the San Francisco office, has recently resigned to accept the position of consulting engineer and general mine manager for the Marsman Company of California. His new address is 2504 Russ Building, San Francisco, Calif.

Stanley M. Moos, mining and metallurgical engineer, who has been Eastern manager for Denver Equipment Co. for the last two years, has been made general manager of that company's newly organized subsidiary in Mexico, Denver Equipment Co., S. A. His headquarters will be in Edificio Jalisco, Calle Ejido No. 7, Mexico, D. F.

Simon H. Ash, chief engineer, Metal and Nonmetal Section, Mineral Production Security Division of the U. S. Bureau of Mines, has been commissioned as senior engineer in the U. S. Public Health Service and assigned to the Medical Division of the Office of Civilian Defense as chief of the Rescue Section.

John A. Burgess, manager of the Carson Hill Gold Mining Corp., at Melones, Calif., for the past ten years, has resigned from that position to take the agency for Metals Reserve Co., Yosemite Tungsten Project, in Yosemite National Park. His business address will be Sonora, Calif.

J. H. Duncan, formerly of the Spruce Pine, N. C., office of the Colonial Mica Corp., has been made manager of the Asheville, N. C., office, which is headquarters for the Southern territory covered by the corporation. **William J. Alexander,** chief field engineer, also has been transferred from the Spruce Pine to the Asheville office. The field office at Spruce Pine is being continued.

C. O. Applehagen, manager of sales of the Interlake Iron Corp. at Duluth, retired May 1, 1943, after 41 years' service with the company. He will be succeeded by **George S. Lockwood, Jr.,** who has been his assistant since 1940.

Carl J. Walden, former assistant cashier of First National Bank, at Bonners Ferry, Idaho, is now accountant for the Sierra Zinc Co., at Leadpoint, Stevens County, and **Truman (Cy) Higginbotham,** formerly general manager of the Idaho Continental mine at Porthill, Idaho, is superintendent of the Sierra Zinc.

C. H. Carlton, superintendent of the Ajax mine, at Cripple Creek, has been transferred to the laboratory of the Golden Cycle mill. He will be engaged in the treatment of zinc-lead ores, now being handled in the interest of the war effort. **Earl Bebee,** superintendent of the Rose Nicol and other U. G. M. properties, has been placed in charge of the Ajax operations.

C. W. Handy has been elected chairman of the board of Handy & Harman, dealers in silver and precious metals, of New York. Other officials chosen at the organization meeting of the board are **G. H. Niemeyer,** president; **R. H. Leach,** vice president; **H. W. Boynton,** treasurer; and **H. W. Spaulding,** secretary. **Judson C. Travis,** formerly assistant to the president, and recently elected to the board to replace H. H. DeLoss, deceased, was elected vice president in charge of sales.

Chester A. Beatty has joined the board of the Central Mining & Investment Corp., Ltd., of London and Johannesburg, an investment and financial enterprise mainly connected with the South African mining industry. **Sir R. Sothern Holland, Bart.,** has become chairman of the board; **A. J. Brett,** executive director, has been made managing director; **R. Walker** has been elected to the board and becomes assistant managing director; and **W. H. A. Lawrence** has been appointed general manager in Johannesburg.

W. B. Phelps, engineer long connected with the Tom Reed mine, at Oatman, Ariz., and lately directing operations of tungsten mines in Nevada, has been appointed superintendent for the Getchell Mine, Inc., in Humboldt County, Nev. In this position he succeeds **Fred Wise,** superintendent for five and a half years and who left recently for an army engineers' training base in Virginia.

Fred W. Nobs, manager for the Empire Star Mines Co., Ltd. at Grass Valley, Calif., and directing other Western operations for the Newmont Mining Corp., lately inspected the open-cut cinnabar mine and two rotary furnaces of the New Verde Mining Co., a Newmont subsidiary, in the Ivanhoe district of western Elko County, Nev.

A. K. Muir has been elected 1943 chairman of the Toronto branch of the Canadian Institute of Mining and Metallurgy. **Mr. Muir is managing director of Black Donald Graphite, Ltd., which has brought the old graphite deposits of the Black Donald property, near Calabogie,** Ontario, into production. He is also a director of International Vanadium Corp., a Ventures affiliate engaged in the development of metals and minerals that are essential to the prosecution of the war.

G. J. Ballmer, assistant superintendent of the Kennecott Copper Company open pit at Santa Rita, gave the commencement address at the New Mexico School of Mines at the close of the year. Mr. Ballmer graduated from this school eighteen years ago. An important part of the ceremonies was the conferring on him of the honorary degree of Engineer of Mines.

Dr. G. K. Williams, acting general superintendent of Broken Hill Associated Smelters Pty. Ltd., Port Pirie, South Australia, has been awarded the medal of the Australasian Institute of Mining and Metallurgy for 1942, in recognition of the outstanding merit of his contribution to the science of lead metallurgy through the invention, development and application of his process for the continuous and full refining of silver-lead bullion. The process is in operation at the works of the Broken Hill Associated Smelters at Port Pirie, which is the only plant where continuous refining of lead is practised in the world.

James H. McGraw, Jr., chairman of the board of directors and president of McGraw-Hill Publishing Co., has been appointed regional chairman of the Committee for Economic Development for New York State. The problems of small business, the impact of taxation upon incentives in business, and means whereby postwar planning may be stimulated and aided are among the main objectives of the committee. Its program of national research will coordinate procedure and assure collaboration in industry groups in New York City and by means of community committees in up-State New York. **Colonel Willard T. Chevalier,** publisher of *Business Week,* was selected as vice chairman for the New York area. Mr. McGraw described the committee program as a "first class" remedy for New York City's worries about losing its commercial position.

OBITUARY

Emory E. Smith, founder of Smith, Emery & Co., of San Francisco, Calif., consulting engineers, died on May 1 at the age of 76.

Harold G. Glenn, of Duluth, general superintendent of the Zenith furnace division of the Interlake Iron Corp., died May 12. He had been with the Zenith furnace for the past 15 years.

Carl Tanner, mining director and vice-president of the Highland Chief Gold Mines Co., of Oatman, Ariz., died recently. Mr. Tanner had operated in and around Oatman for fifty years.

George W. Fry, well-known mining man in the early days of the Cripple Creek district, and formerly associated with the Tutt & Penrose interests during the first years of the Gold camp's history, died on March 11, 1943, at his

home in Palo Alto, Colo. He was formerly a partner in the brokerage firm of Burke & Fry.

Frederick Eugene Turner, 65, general superintendent of the Exploration Syndicate, Inc., and former superintendent at the Ohio Copper mine, at Bingham, died at his Salt Lake home on May 16, 1943.

Edmund M. Morrill, professor in the department of metallurgy at Columbia University until his retirement 18 months ago, died at his home at Long Branch, N. J., on May 17. His age was 74.

H. Ben L'Hommedieu, mining engineer of Flushing, Long Island, N. Y., formerly professionally active in explorations for important British mining interests, died at Poughkeepsie, N. Y., on April 30 last. He was 67.

F. C. Williamson, inventor of the Williamson ball mill and founder of Williamson Manufacturing Co., of San Francisco, died in Chicago on May 21, aged 59. Mr. Williamson attended the Michigan College of Mines and began his career in Cobalt, Ontario.

William J. Walworth, vice president, secretary, and a director of the Howe Sound Co., and associated, also, with the Breece, Calera, Britannia, Croesus, El Potosi, and Torbrit mining properties, died in New Rochelle, N. Y., on May 19, at the age of 71. His entire business career had been devoted to mining operations.

William Lee Powers, Little Rock, Ark., general manager of the American Cyanamid & Chemical Company's properties in Pulaski county, died in a Little Rock hospital Sunday, April 17. After joining the company in 1918 as chief of mines, and making several trips to South America to develop mines there he came to Little Rock, in 1934.

Willard A. Bondurant, pioneer miner, store operator, and freighter as well as co-founder of the town of Buckeye, in Arizona, died at Phoenix early in May at the age of 74. Mr. Bondurant came to Arizona 57 years ago, settling in Minneha Flats, where he conducted a store for a number of years. Later he operated a stage line and freighting outfit between Phoenix and the booming mining camps in the vicinity of Prescott. During the past twenty years he has been actively engaged in mining. At the time of his death he was vice president of the Hidden Treasure Mining Co., operating the property of that name near Bumblebee.

Sylvester Quayle Cannon, mining engineer, prominent in Utah mining, civic, business, and Mormon Church affairs, died at Salt Lake City, Utah, on May 29, at the age of 79. Mr. Cannon was an alumnus of M.I.T., having been graduated with the B.Sc. degree in mining in 1899. He was a member of the Latter Day Saints Church Council of Twelve Apostles and was presiding Bishop of that Church from 1925 to 1938. He was also president of Deseret News Publishing Co. and of Radio Service Corporation of America, operating Station KSL, of Salt Lake City.

Harry Lane Englebright, Representative in the United States Congress of the Second Congressional District in California, and Republican whip of the House of Representatives, died at the Naval hospital at Bethesda, Md., on May 13 after a brief illness. His age was 59. Mr. Englebright was a mining engineer by profession, having been an alumnus of the University of California, and was actively connected with various mining enterprises in California. In Congress he succeeded his father, William F. Englebright, who had represented practically the same California districts in the 59th, 60th, and 61st Congresses. H. L. Englebright had held office since 1926. His home was in Nevada City, Calif. He was held in highest esteem by his colleagues in Congress of both political parties. John McCormack, Democratic leader, on May 13 said that he had occupied a "position of honor because he was honorable and occupied a position of trust because he was trustworthy." Sam Rayburn, Speaker of the House, appointed a committee of Senators and Representatives to attend the final rites.

An Appreciation of Colonel Percy E. Barbour

In remembering Colonel Barbour, dead at Lima, Peru, on May 4 after a short attack of acute leukemia, at the age of 67, the two outstanding impressions left are those of his essential straightforwardness and crystal-clear honesty, and the zeal with which he served the ideal of preparedness by the United States. As to the first, one could not meet him without being struck by his intolerance of evasion. As to the second, it was necessary to know him more intimately to realize the hours spent by him on this absorbing interest.

He had been a member of the Massachusetts Naval Brigade as far back as 1898–1900: a lieutenant with the Maine Coast Artillery, 1914–16; with the Twenty-second Engineers (New York) on the Mexican border in 1916–1917; captain in the Engineer Corps, U.S.A., 1918–1919, afterward going back in the Engineers' Reserve Corps and progressing through the various grades from captain until he became colonel of the 363d Engineers in 1934, commanding the regiment until his retirement for age in 1939. While the Reserve requirements for promotion were 300 hours in a five-year commission period, Colonel Barbour devoted over 200 hours a year to his Reserve work—at least four hours in each week. In addition, he acted for a time as secretary and treasurer of the American Military Engineers and was its medallist in 1928 for distinguished services, besides doing an immense amount of work on strategic minerals in connection with the activities of the American Institute of Mining and Metallurgical Engineers, and later the Mining and Metallurgical Society of America. It was a matter of much regret to him that he could not be called back for active duty in the present war, which he had so clearly foreseen.

In 1915 he joined the editorial staff of the *Engineering and Mining Journal, of* which he became managing editor in 1916, and from that period most of his time was given to literary and editorial work on the *Journal* until he left to organize the New York State Troopers in 1917, later as Assistant Secretary of the American Institute of Mining and Metallurgical Engineers, and founder of *Mining and Metallurgy*, later still as secretary of the Mining and Metallurgical Society of America, as frequent contributor to the *New York Times Analyst* and to the *American Metal Market*, and as author of "Secondary Copper" and other important semi-engineering semi-economic papers. In all that he did there was a disdain for any half-statements or subterfuge that was very refreshing. One always knew where Colonel Barbour stood and what he meant. With all of this, Colonel Barbour carried on a considerable consulting practice since 1927.

He had been in Goldfield, Nev., in the early days when Goldfield was a wide-open camp, and had not only engaged in engineering work, but had also acted as deputy sheriff of Esmeralda County for a time. Later, he kept alive the marginal operation of the Uwarra Mining Co., of Candor, N. C., from 1911–1914, until fire destroyed most of the plant.

He went to Lima about five months ago on a mission for the State Department and was as much a war casualty as though he had been in Tunisia. It is a poorer world without him.

DONALD M. LIDDELL,
Lt. Col., A. C.

A LETTER

Briquetting Iron Ores

THE EDITOR:

I NOTICE on Page 71 of the April 1943 issue of *Engineer and Mining Journal* an article entitled "Process for Briquetting Soft Iron Ores" and saying that patents are being sought on this process.

If you will turn back in your files to 1905 to 1910, or the Transactions of the A.I.M.E., you will find that such a process was very completely described, and was extensively used in Sweden, and one or more installations were in operation in this country. Among others, I believe the General Chemical Co. used it at one of its plants. This was known as the Gröndahl process.

The ore was briquetted under high pressure, and the bricks were placed on cars which had firebrick-lined tops and which were arranged in such a manner that their wheels ran in an air-cooled tunnel while the tops of the cars with their load of bricks passed slowly through a long arched tunnel in which a high temperature was maintained. The bricks became burned or sintered on the outside, and were hard and could stand any amount of handling. They made a very satisfactory blast-furnace product. They would have been equally satisfactory as a product for the open hearth. So far as I know, the reason for abandoning the process was the cost of operation.

I should say that based on these facts as I know them, no one today would have a ghost of a chance of getting any patent on any such process.

H. J. STEHLI

Metals Reserve Co. Revises Domestic Chrome and Manganese Price Schedules to Simplify Purchasing Policy

Base price of chrome raised and premiums and penalties on both manganese and chrome are changed to afford higher income to most producers

THE PRICE SCHEDULE governing sales of domestic manganese ores and concentrates to the Metals Reserve Co., Washington, D. C., issued recently, contains revisions in premium payments and penalties that will result in a moderate increase in the settlement basis. The base price in the schedule that became effective May 15, 1943, continues at $1 per unit of contained manganese on 48 percent Mn ores or concentrates.

Regular contracts cover from 1,000 to 10,000 tons per contract. On tonnages exceeding 10,000 tons, contracts may be obtained through individual negotiation. Small lots of not less than 10 tons will be accepted at the purchase depots maintained by Metals Reserve on the basis of $1 per unit, subject to premiums and penalties.

Deliveries against contracts must be completed within a maximum of 18 months. If delivery of 20 percent of the tonnage contracted for has not been made within six months of date of contract, the buyer may cancel the contract forthwith.

Ores and concentrates will not be accepted under the new schedule which contain less than 35 percent manganese, more than 3 percent zinc, or more than 1 percent phosphorus.

Size specifications call for material not in excess of 12 inches and not more than 25 percent to pass a 20-mesh screen. Other ore will be accepted only on a negotiated basis.

A premium of one-half cent per unit of contained manganese will be paid for each 1 percent of manganese content above 48 percent.

One-half cent per unit of contained manganese will be added to the base price for each 1 percent of iron below 6 percent. No extra payment for material containing less than 11 percent silica plus alumina content.

Penalties will be exacted of 1c. per unit of contained manganese for each 1 percent of manganese content below 48 percent down to and including 44 percent; 4c., plus 1½c., per unit for each 1 percent of manganese content below 44 percent down to and including 40 percent; 10c., plus 2c., per unit for each 1 percent of manganese content below 40 percent down to and including 35 percent. The penalty for iron content above 6 percent is 1c. per unit for each 1 percent of iron content up to and including 8 percent; 2c., plus three-quarters of a cent, per unit for each 1 percent of iron content above 8 percent. Penalties for silica plus alumina content above 11 percent are 1c. per unit for each 1 percent of silica plus alumina content up to and including 15 percent; 4c., plus three-quarters of a cent, per unit for each 1 percent of silica plus alumina content above 15 percent.

Freight allowed from seller's nearest convenient rail station to buyer's stockpile.

The holder of any outstanding contract covering manganese ores or concentrates entered into pursuant to the terms of previous circulars may avail himself of the benefits contained in the latest circular in so far as the undelivered portion of the material under contract is concerned.

Truckload lots are not accepted under contracts.

The new price schedule for purchases of domestic chrome ore by the Metals Reserve Co. that became effective May 15, 1943, contains the following information governing transactions:

Quantity[a]: 1,000 to 10,000 long tons (larger tonnages subject to individual negotiation).

Term of contract: Deliveries must be completed within a maximum of 18 months. If 20 percent of the tonnage contracted for has not been made within six months, buyer may cancel contract.

Quality: Ores and concentrates will not be accepted which contain less than 35 percent chromic oxide, and a chromium to iron ratio of less than 1.50 to 1, except by special arrangement.

Size: None to exceed 12 inches.

Price: Per long ton of dry weight, f.o.b. cars at stockpile designated by buyer. Base price is $52.80 per long ton for ores and concentrates analyzing 48 percent chromic oxide and Cr to Fe ratio 3 to 1. A premium of $1.10 per ton for each 1 percent of chromic oxide content above 48 percent; and $1.50 per ton for each 0.10 to 1 ratio up to but not exceeding 3.50 to 1. Penalties will be exacted at $1.10 per ton for each 1 percent of chromic oxide content down to and including 35 percent; $1.50 for each 0.10 to 1 ratio below 3 to 1 down to and including 2 to 1; and on ores and concentrates below 2 to 1 ratio, $15 plus $1 per ton for each 0.10 to 1 ratio down to and including 1.50 to 1.

Metals Reserve will make allowances for each long ton accepted equal to the railroad freight tariff per long ton from seller's nearest convenient rail station to buyer's stockpile.

Cost of sampling and analysis is for account of buyer. Buyer also pays for weighing and unloading onto stockpile.

Terms are subject to change without notice, and the terms and provisions of each contract will be based on conditions and circumstances existing at the time of acceptance.

(a) On lots of not less than 10 tons, delivered at purchase depots, purchases will be made at base price with applicable premiums and penalties.

NEWS OF THE INDUSTRY

Metals Reserve Raises Strategic Mica Prices

TO PREVENT A DEPLETION of stockpile caused by increased requirements of strategic mica, Colonial Mica Corp., agent of the Metals Reserve Co., has provided for a substantial increase in income to mine operators, especially those which produce mainly small sizes. A new schedule of buying prices was made effective May 24.

The new schedules, sent to the operators in a letter from the Colonial Mica Corp., are optional with the producers. Present schedules continue in force until Dec. 31 of this year. However, as the new schedules are more advantageous to most producers, it is believed certain that few operators will elect to continue selling at the old arrangement. Inducements contained in the new schedules are aimed at greater production of small sizes, most critically needed at this time.

Colonial Mica Corp., in conjunction with WPB, some time ago began a series of studies and investigations which have finally resulted in the changes now made effective.

Under the new schedules operators will be able to eliminate much of the sorting and grading heretofore required before marketing. This will allow savings in labor costs and manpower. Thus by simplification of processing, lower production cost and increased price in some grades, a more uniform flow of supplies is assured.

Notice to Subscribers

DESPITE EFFORTS of the publishers to maintain regular printing and mailing schedules for *E.&M.J.*, the strain of war occasionally disrupts the best laid plans and frequently delays delivery of the *Journal*. If you do not receive your copy as usual please wait a reasonable length of time before entering a complaint. The delay is probably due to exceptionally heavy burdens on the postal system and the railroads, and your copy may arrive about the time your complaint is received. Your cooperation in this matter will lighten the load of correspondence in our circulation department.

Bureau Releases 1942 Production Statistics

IN 1942 the total mine production of recoverable copper in the United States (Alaska included) was about 1,072,003 short tons, an increase of 12 percent over 1941, according to preliminary figures of the Denver office of the Bureau of Mines. The output is the largest in the history of the United States.

Of the total mine production of copper in 1942 in the United States (Alaska included) Arizona contributed 36 percent, Utah 29 percent, Montana 13 percent, Nevada 8 percent, New Mexico 7 percent, Michigan 4 percent, and other states 3 percent.

The mine output of copper was valued at $257,280,720 in 1942, compared with $226,123,164 in 1941, an increase of 14 percent. Average weighted price per pound used by the Bureau of Mines in the preliminary calculations for 1942 was $0.12; the average weighted price used for 1941 was $0.118.

In 1942 the total mine production of recoverable lead and zinc in the United States and Alaska (including that made into pigments and chemicals direct from ore) was 492,435 short tons of lead and 760,210 short tons of zinc. These figures compare with a production of 461,426 short tons of lead and 749,125 short tons of zinc in 1941 and show that there was a 7 percent increase in the production of lead and a 1½ percent increase in the production of zinc in 1942. The total value of the metals produced in 1942, calculated at the average weighted prices used by the Bureau of Mines of $0.067 per pound for lead and $0.091 per pound for zinc, was $65,986,290 for lead and $138,358,220 for zinc.

Of domestic lead production, Southeast Missouri led with 40 percent of the total. The Tri-State district produced 7 percent, and the Western states 52 percent. The more important Western producing states, listed in the order of their importance, were: Idaho, Utah, Montana, Arizona, Colorado, Nevada, New Mexico, Washington, and California.

Of domestic zinc production the Eastern states of New Jersey, New York, Tennessee, and Virginia (listed in order of importance) produced 26 percent. The Tri-State district, of Oklahoma, Kansas, and Missouri, produced 31 percent, and Western states produced 43 percent. The principal Western producing states, in order, were: Idaho, Montana, Utah, New Mexico, Arizona, Colorado, Nevada, Washington and California.

Fluorspar Miner Killed By Caving Ground

ON MAY 21 a cave-in at the Mary Helen fluorspar mine, near Mexico, Ky., trapped five men, killing one of them, Tom Fuller, the mine foreman. The four remaining men were rescued after being trapped for five hours and brought to the surface unharmed. The mine is the property of the United States Coal & Coke Co.

Quicksilver Purchase Program Extended

TO MAINTAIN and further stimulate domestic production of quicksilver, the "floor" under the price structure of the metal has been extended by the Metals Reserve Co. to Dec. 31, 1944. On recommendation of WPB, the Government's buying agency announced that it will continue to absorb quicksilver that cannot be disposed of otherwise on the basis of $192 per flask of 76 lb., f.o.b. warehouse New York. On deliveries made outside of New York, the program provides for a deduction of $4 per flask to cover the shipping and handling charges included in the $192 basis.

In the open market, quotations for quicksilver in New York still range from $196 to $198 per flask.

Total deliveries from a "qualified" producer during the calendar year 1944 to Metals Reserve cannot exceed 300 flasks, except in those cases where the producer has made special arrangements to furnish larger quantities. Qualified producers are at liberty to sell all or any part of their production to others than Metals Reserve.

A qualified producer is defined as one who can show that he did not produce more than 90 flasks of quicksilver during April, 1942. However, any domestic producer whose production in that month exceeded 90 flasks will be afforded the opportunity to negotiate a contract with Metals Reserve under the extended buying program.

Metals Reserve Co., the terms of sale state, may, on or after Dec. 31, 1943, give notice of its intention to terminate the program in 30 days under the following conditions: (a) Accept delivery of a quantity of mercury equal to the total unfilled production at the same net price paid to the producer under the contract, or (b) settle in cash for the unfilled production on the basis of $20 per flask.

Copper Recovery Program Unearths Big Tonnage

THE EXTENT to which the War Production Board's copper recovery program is aiding the nation's war industries is shown by the fact that to date 197,000,000 lb. of idle and excessive copper, both in primary and fabricated forms, have been allocated for war use. This amount represents two-thirds of the total amount of copper thus far reported under the program.

Of the remaining 100,000,000 lb. reported, approximately 36,000,000 lb. consist of assembled products contaminated with materials not suitable for copper scrap. Arrangements for the movement of the remainder are currently being made at Copper Recovery Corporation.

Of the 197,000,000 lb. thus far allocated, approximately 62,000,000 lb. are in the form of fabricated copper and copper-base alloy. Of the total allocated, 56,000,000 lb. have been sold for use in present forms; 93,500,000 lb. have been allocated for remelting, and 30,000,000 lb. have been directed into the regular scrap market.

Bolivian President Says Tin Prices Must Rise

IN MID-MAY, while in New York, Bolivian President General Enrique Penaranda stated that rising costs of production will make it necessary to increase the price of Bolivian tin concentrates, on which the United States now depends for new tin supplies. The present contract between Metals Reserve Co. and the Bolivian tin producers, excepting the Patiño company, whose output goes to Great Britain, expires on June 30, 1943. The price under this contract is 60c. per pound f.o.b. South American ports, having been raised in January 1942 from 48½c. c.i.f. United States ports.

At present the principal source of Bolivian foreign credits is tin exports, which are also taxed heavily to provide the principal source of government revenues.

Recent utterances by President Roosevelt and Vice-President Wallace, condoning the defaulting on a Bolivian loan floated in this country several years ago and expressing sympathy for the "pitiful" condition of Bolivian miners, are interpreted in the trade to indicate that the Administration will back the proposed increase in the price of tin.

Patino Mines to Install Sink-Float Plant

AT THE ANNUAL MEETING of stockholders of Patiño Mines & Enterprises, Consolidated, Inc., Claude F. Garesche, vice president, announced the signing of contracts to install a sink-float plant to eliminate hand picking of the ore in the company's Bolivian tin mines. Mr. Garesche stated that the plant would be completed about the end of this year and would cost from $200,000 to $250,000. It is expected that the metallurgical improvements due to the installation will pay out the investment in six to eight months.

Mr. Garesche estimated that the company's 1943 production would be about 10 percent in excess of the 13,491 tons produced in 1942. All the company's production is now going to Great Britain and is receiving the same price paid by Metals Reserve Co. to other Bolivian tin producers—namely, 60c. per pound f.o.b. South American ports.

Scrugham Will Introduce Stockpile Legislation

IN MID-MAY Senator James Scrugham, of Nevada, chairman of the Mining and Minerals Subcommittee of the Senate Committee on Small Business, announced that legislation governing the accumulation and administration of mineral stockpiles would be introduced as soon as legal details can be worked out. The Senator announced himself as in favor of large stockpiles, but as against their utilization to coerce industry.

GIVE 'EM ALL THEY NEED

. . . and more

THOSE fellows on our fighting fronts aren't asking a lot . . . and they're *giving* everything. To provide them with fighting equipment is a privilege as well as a duty.

One way to help, here at home, is to practise strict conservation. Buy the best and longest-lasting tools and equipment. Take care of everything and drain the last ounce of use from the things you use. That frees our factories, workers, and materials. It turns them loose to provide the weapons of war.

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Report on Olivine as Magnesium Source

SEVERAL HUNDRED million tons of olivine, a common mineral regarded as a possible source of magnesium metal, are known to exist in the United States, according to a report just published by the Bureau of Mines. Averaging 45 to 49 percent magnesia, the principal reserves of olivine are in the eastern seaboard states of North Carolina and Georgia and in the Puget Sound region of the Pacific Coast.

The North Carolina and Georgia deposits are estimated at about 230 million tons, but the most extensive and best quality olivine occurs in the Twin Sisters Mountain region about 90 miles north of Seattle, Wash., the report states. No figures have been published regarding the size of this deposit, although the Geological Survey estimates that the reserves run into "millions of tons." Another large deposit estimated at 50 million tons is on the southeast corner of Cypress Island, in Puget Sound some 80 miles northwest of Seattle.

In announcing publication of the Bureau's report on the occurrence, geology, and economic aspects of olivine, Dr. R. R. Sayers, director, also revealed that Bureau metallurgists at Norris, Tenn., are engaged in research to develop a low-cost process for extracting magnesium oxide from olivine. Heretofore, about 98 percent of all olivine produced in this country has been used for refractories and the remainder for magnesium chemicals.

A copy of Information Circular 7329, "Olivine," may be obtained without cost from the Bureau of Mines, Department of the Interior, Washington, D. C.

WPB Would Release Treasury Silver

IN A HEARING before the Senate Banking and Currency Committee on April 28, Richard J. Lund, chief of the Miscellaneous Minerals Division of WPB, explained the statistical position of silver and opposed legislation that would restrain or impair the use of Treasury "free" silver for essential war industry.

"Estimated industrial consumption of silver in this country in 1942 amounted to about 48,000,000 oz. for essential uses and 73,000,000 oz. for non-essential uses, a total of 121,000,000 oz.," Mr. Lund declared, "At the end of the year," he said, "estimated consumption for essential uses was running at the rate of about 100,000,000 oz. a year.

"For 1943, WPB estimates consumption for essential uses at 139,000,000 oz. and for non-essential uses 30,000,000 oz. This does not take into account potential demands, which might consume an additional 40,000,000 to 50,000,000 oz. In addition, there are substantial foreign requirements for coinage and industrial use, estimated at 40,000,000 to 50,000,000 oz. Total requirements would appear, therefore, to be a minimum of 210,000,000 oz., with a potential of 260,000,000 oz.

"Supplies in 1943 are now estimated at 45,000,000 oz. from domestic production and 70,000,000 from imports, a total of 115,000,000 oz. Estimated secondary production, plus Metals Reserve Co. stocks and reserves of 'silver ordinary' in the Treasury, bring the supply to approximately 162,000,000 oz. We are thus faced with an estimated deficit for the year of not less than 48,000,000 oz. and a possible deficit of twice that amount.

"According to WPB calculations, Treasury 'free' silver amounts to about 1,288,000,000 oz., or about 44,000 short tons. Of this total, a direct commitment has been made to the Army for about 245,000,000 oz. (8,400 tons) for war use, and the Treasury agreed with the WPB in 1942 to allocate to Defense Plant Corp. up to 1,000,000,000 oz. for manufacture into busbars, transformer windings, and other non-consumptive uses, the silver to be returned to the Treasury after the war.

"Of the billion ounces allocated to the busbar program, about 560,000,000 oz. (19,247 tons), has been certified by WPB for use in designated war plants, leaving a balance of unallocated silver of about 440,000,000 oz. (15,000 tons)."

Mr. Lund made it clear that WPB would prefer the enactment of legislation which will authorize the release of Treasury silver for uses connected with the war effort.

WPB Says Mica Is Still Much in Demand

AMERICA'S NEED for mica has not diminished despite recent reports that a substitute has been found, according to the Mica-Graphite Division, War Production Board. Military requirements for mica, especially in the higher qualities, are not yet affected by any substitutes.

Though it is true that several promising new materials are in the process of the development, and though each of these has some characteristics similar to those of mica, the Division points out in a letter to the industry that none of them possesses the particular combination of characteristics enjoyed by mica.

"Each of them may, if or when they are fully developed and their use is approved and adopted by the Armed Services, replace mica to a limited extent in certain applications," the letter says. "But none of these substitutes is as yet in actual production on any scale beyond laboratory work, and, further, there has to date been very little actual adoption either by the Armed Services or by prime contractors of components containing any of these new materials as a replacement for mica.

"While these substitutes may eventually replace mica to the extent of 10 to 15 percent of total mica requirements, remaining requirements will still absorb all expected production of mica in the higher qualities.

"The military program still requires very large quantities of mica, especially in the better qualities. No mica miner should feel that his output is no longer needed for the war effort, because the opposite is the case. It is expected that all possible production of high-quality mica will continue to be absorbed for military uses for the duration of the war. United States government agencies, both in this country and in certain foreign countries, will continue to procure mica and no reduction in the buying program is contemplated."

Electrolytic Manganese Plant Is Enlarged

THE ELECTRO MANGANESE CORP. has recently completed and put into successful operation the second unit of its manganese electro-winning plant at Knoxville, Tenn. This unit was certified by the Ferro-alloys Branch of the War Production Board and was built under contract with Defense Plant Corp., RFC subsidiary. This addition has doubled the rate of electrolytic manganese production. E. M. Wanamaker is president and general manager of the Electro Manganese Corp., R. H. Cromwell is vice president, and R. H. Bennett managing director.

Survey and Bureau Adopt New Reserve Terminology

A NEW METHOD for classifying ore reserves has been adopted by the Bureau of Mines and the Geological Survey as a means of providing a more comprehensive picture of the Nation's mineral resources. The two agencies will use the terms "measured ore," "indicated ore," and "inferred ore" in defining the extent of mineral deposits. The following definitions will govern the use of the three terms:

"Measured ore is ore for which tonnage is computed from dimensions revealed in outcrops, trenches, workings, and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling, and measurements are so closely spaced and the geologic character is defined so well that the size, shape, and mineral content are well established. The computed tonnage and grade are judged to be accurate within limits which are stated, and no such limit is judged to differ from the computed tonnage or grade by more than 20 percent."

"Indicated ore is ore for which tonnage and grade are computed partly from specific measurements, samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to outline the ore completely or to establish its grade throughout."

"Inferred ore is ore for which quantitative estimates are based largely on broad knowledge of the geologic character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition for which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence. Estimates of inferred ore should include a statement of the spacial limits within which the inferred ore may lie."

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NEVADA

Large Molybdenum Plant Planned Near Tonopah

Basic Magnesium to use truck haulage—State advisory committee formed—New orebody reported at Rio Tinto

▶ Early construction of a 2,000-ton molybdenum plant on claims held under option by the U. S. Vanadium Corp. in the Liberty district, 20 miles north of Tonopah, Nye County, was forecast in reports attributed to engineers of the U. S. Bureau of Mines. Ground involved covers part of a large number of patented claims embraced in the old Liberty silver-lead mine, worked in the early '70s by Mexican miners and later operated by the Tonopah Liberty Mining Co., which built a 125-ton gravity concentration mill. Principal owner is Lee Hand, of Tonopah, who bought the claims for delinquent taxes. United States Vanadium took over the molybdenite group of 1936 and a considerable amount of development work was done under direction of Clarence Hall, but the project was abandoned in the following year. Reports stated Defense Plant Corp. will provide construction funds and U. S. Vanadium will operate as agent for Metals Reserve Co., as it is now operating the tungsten plant at Salt Lake City. A 10-ton sample of the molybdenite was shipped recently for tests to the Bureau of Mines experiment station at Salt Lake City.

▶ Magnesium oxide, product of the flotation-calcining plant of the Anaconda-operated Basic Magnesium, Inc., at Gabbs Valley, Nye County, will be shipped hereafter by huge 32-wheel trucks and trailers some 350 miles south by road, the trucking contract having been awarded to Wells, Inc., Reno contractors. This replaces the former rail haul of nearly 1,100 miles by way of Ogden and Salt Lake City. Proposed construction of a railroad south from Goldfield to Las Vegas still awaits approval of Army and Navy engineers as a wartime strategic need, and the decision may hinge on further test work at the Boulder City station of the Bureau of Mines, which has announced success in recovering magnesium from a 400,000,000-ton dolomite deposit at Sloan, less than 30 miles from the magnesium metal plant.

▶ The Cordero Mining Co., D. Ford McCormick, manager at Denio, Humboldt County, is operating its 125-ton Herreshoff furnace plant at part capacity on cinnabar mined by power shovel from open cuts. Working force has been reduced by the draft and attraction of war-plant wages to 32, against the normal crew of 65 men. In April the company shipped 250 flasks of mercury and in December the output was 500 flasks. The company is an affiliate of Horse Heaven Mines, Inc., of Oregon; both subsidiaries of the Sun Oil Co., of Philadelphia.

▶ An RFC loan has been granted to Mark G. Bradshaw, of Tonopah, engineer and veteran mine operator, to reopen his Endowment silver-lead-zinc mine in the Marietta district, 26 miles southwest of Mina, in Mineral County. Records indicate that the mine produced around $1,500,000 prior to 1885 and lessees made some production in later years. Below the adit level the minerals are chiefly argentite, sphalerite, and galena.

▶ Because of the exhaustion of its budget allowance, the U. S. Bureau of Mines experiment station at Boulder City, Clark County, has been compelled to lay off about 150 employes. This does not affect continued work designed to perfect electrolytic processes in manganese and magnesium metallurgy but will curtail other activities to the prewar level.

▶ The lately formed Sierra Minerals Corp., operating a 25-ton flotation mill at the East Walker mine, near Wichman, Lyon County, has shipped some concentrate containing gold, silver, lead, and copper to the Selby smelter of the A.S.&R. Co., on San Francisco bay. The mine has been equipped in recent months under direction of Joseph R. Geronimo, of Yerington.

▶ The Bray antimony mine, at Big Creek, south of Austin, in Lander County, an early-day producer of note, is being reopened by Tony Romano, Robert Roecker, and California associates, who are preparing to ship their product to a Texas smelter. The mine produced during the '70s and again in the '90s, when a considerable quantity of 50 percent ore was shipped. The area has been one of the most productive of stibnite in Nevada.

▶ Its open-cut gold mine and 350-ton cyanide mill closed since the October WPB order, the Northumberland Mining Co., J. C. Perkins, of Tonopah, manager, has maintained its plant in operating condition with the purpose of resuming when possible. It is the purpose then to install a 300-ton calcining furnace for primary roast before the ore enters the cyanide circuit, a procedure in practice at the Getchell mine, where arsenic is now an important by-product. Walter Haggerty is president.

▶ John A. Payne, president of the Consolidated Coppermines Corp., operating at Kimberly and shipping 9,000 tons per day of copper ore to the Kennecott smelter at McGill, has recommended to the board of directors that a decision on dividend policy be deferred pending action on his request for downward revision of the company's production quota.

▶ The Gilded Age Mining Co. is said to be producing a high-grade scheelite concentrate in its 25-ton tungsten mill on its Gold King mine, in the Black Horse district, White Pine County, a short distance northeast of its productive gold mine at Osceola, which made reported gold production of $175,000 in 1939. Development work has been conducted in late months on two other tungsten properties in nearby districts. The company has its main office in Grosse Pointe, Mich. John B. Blanchard, of Grosse Point, is president, and R. E. Margenau, of Ely, is manager.

▶ The Swales Mountain mine, in which zinc-lead-silver orebodies of large volume have been developed by intermittent work extending over many years, and which is situated 20 miles north of Carlin, in Elko County, has been acquired by the Angelus Basic Copper, a syndicate composed of southern California men. Road work has been in progress and a compressor and other equipment units have been delivered. The group also has acquired a large group of copper claims near Yerington, Lyon County, adjoining ground now being drilled by Anaconda interests. Allan A. MacLean, of Los Angeles, is head of the syndicate and J. P. McGlynn is superintendent at Carlin.

▶ Members of a state advisory mining board, created at the December session of the Nevada Legislature, named lately by Governor E. P. Carville, are: J. C. Kinnear, of McGill, manager for the Nevada division of Kennecott Copper Corp.; Horace A. Johnson, resident manager for Tonopah Mining Co., of Nevada; Fred E. Gray, manager for Desert Silver, Inc., at Nivloc; Eric J. Schrader, consulting engineer of Reno; Paul Gemmill, geologist for Prince Consolidated Mining Co., of Pioche; William Donovan, head and manager for the Silver Hill Mining Co. at Silver City, and P. A. Keegel, of Las Vegas, engineer and former manager of productive gold mines in the Eldorado district in Clark County. An organization meeting of the board is to be held soon.

▶ Copper mines in the Contact district, northeastern Elko County, that made some production during the first World War, are being reopened by the Marshall Mining Co., of California, and some small shipments have been made over the Wells-Rogerson branch railroad to a Utah smelter.

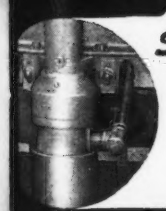
▶ With completion of a new road and with new heavy-duty trucks, the Golconda Mining Co. is shipping around 60 tons per day of high-grade manganese ore from its leased Black Diablo mine, in the Pumpernickel district, northern Pershing County, 22 miles south of the Golconda rail point. Hollis E. Chatwin is manager. The product goes to the Columbia Steel plant at Ironton, Utah, a subsidiary of U. S. Steel.

▶ The East Standard Mining Co. of Utah has acquired old zinc-lead mines at Freiberg, western Lincoln County, and has made several shipments to the Midvale smelter of the U. S. Smelting, Refining & Mining Co. Charles W. Dodge, vice president, is said to have announced that a 150-ton concentrating mill on a Utah property of the company will be moved to the Freiberg mine. Ted Oxborrow, of Ely, superintendent, is driving a new tunnel.

▶ Miners in the employ of the Mountain City Copper Co. in northern Elko County, say there is truth in reports that a new orebody of major importance has been opened in the far western part of the company's Rio Tinto mine in raising to the surface from the main 700-ft. haulage level for air connection. This point was said to be near claim boundaries of the Mountain City Consolidated Copper Co. and the Rio Grande Copper Co. J. J. Lillie is manager.

DENVER *Supercharged* FLOTATION

Rear view of 4-cell No. 30 Denver Flotation Machine showing supercharged air header and connections. With this machine it is possible to secure the three flotation conditions as illustrated below.



Supercharged flotation utilizes low pressure air from 6 to 12 ounces, which is diffused throughout pulp; there is no air-lift or classifying action due to air pressure.

Standard flotation uses the pumping action of the impeller to draw air down standpipe. This is satisfactory for normal operating conditions and for average pulps.

Suppressed flotation or throttling of air is an effective means of control and regulation when required in cleaner, recleaner, or other types of circuits.

BUBBLES *even finer than these dots* are the answer to better performance... the result of Denver *Supercharged* Flotation. The value of this development can best be analyzed by reference to factual data from several prominent companies, all of whom considered their results good *prior* to supercharging:

Plant A **"Tonnage doubled, power 26% less, metallurgy constant."**

Plant B **"Recovery of roughers increased from 68 to 75.1%, power decreased, pine oil consumption reduced 40%.**

Plant C **"Denver Unit Flotation Cells in the grinding circuit were supercharged and this increased the grinding circuit recovery from 46.6 to 73.3%; control also simplified.**

In these plants it is obvious that there has been an outstanding improvement in *some phase* of the work done. While Denver *Supercharged* Flotation is not a "cure-all"... in many plants it will reduce costs and/or improve metallurgical results in *some phase* of the flotation process. A new publication, Bulletin No. F10-B17 gives complete information, write today.

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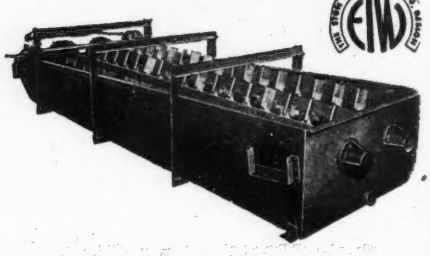

Eagle Log Washer

● The Eagle Paddle Type Log Washer is especially effective in breaking down and removing difficult tough clays and cemented aggregates found in some ores such as bauxite, iron ore, manganese ore, phosphates, and other minerals.

Chilled Semi-Steel Paddles, revolving in opposite directions to the center of the tub, scour the aggregate and break down the foreign material while conveying scoured material up the full length of the tub. Clean wash water introduced through bottom water inlets at the center of the tub provides an upward current of water all through the aggregate as it is conveyed up the tub. The upward currents float the foreign material to the surface where the overflow stream sweeps it out of the tub.

Send us samples of your material for inspection and test. Tell us of your present set-up as we will then be in better position to advise on the application of the Eagle Log Washer to your individual needs.

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CALIFORNIA

Volo Leases Three Copper Properties

Newton copper mine now shipping ore—Gray Eagle property now operating smoothly—Will rerun Copperopolis Company tailings

▶ Shipments of copper ore from the old Newton mine, in Amador County, to a smelter in Utah have commenced. The property, covering about 675 acres, is held under lease by J. H. Lester from Fred Dufrene and associates. Rehabilitation work was started by Lester last year after a shutdown of more than 40 years. The mine is open to the 400 level, and a productive zone at greater depth was disclosed recently by diamond drilling carried out by the U. S. Bureau of Mines.

▶ Volo Mining Co., F. V. Phillips, president and general manager, has leased the Lilyama, Pioneer, and Funny Bug copper mines, in the Pilot Hill district of El Dorado County, and active development is under way. The 150-ton mill near Placerville, which ceased treating chrome ore last December, is again in operation, and flotation equipment has been added to take care of the copper ore shipments. Work is proceeding on a one-shift basis, and the crew will be increased as operations expand.

▶ Patterson and Spivey have resumed work at the White Pine chrome mine near Quincy, Plumas County, following a winter shutdown. The mine produced more than 400 tons of 50 percent grade ore last fall.

▶ Operations are proceeding satisfactorily at the Gray Eagle copper mine, operated by Gray Eagle Copper Co., a Newmont subsidiary, near Happy Camp, Siskiyou County. Mine production is transported to the new concentrator with a rated capacity of 550 tons, in Granby-type cars drawn by battery locomotives. The flow-sheet of the concentrator differs little from that of the newer plants in Arizona, and includes crushing in a large jaw crusher, followed by a standard cone crusher and a short-head cone crusher, with vibrating screens in open circuit between the primary and secondary crushers, one-stage grinding, thickening, and filtering. Finished concentrates are hauled in 10-ton trucks to the loading station at Yreka, about 80 miles distant, for shipment to Tacoma. The tram now under construction between the concentrator and Thompson Creek, a distance of 3½ miles, will cut the haulage distance at least 20 miles. Robert J. Hendricks is general manager; W. P. Goss, assistant general manager; Duncan L. King, mill superintendent; and Jack Widauf, mine foreman.

▶ Preliminary work to re-treat a large tonnage of copper tailings available at the Copperopolis mine, in Calaveras County, has been started by the Pacific Mining Co., P. R. Bradley, Jr., manager. About 20 men are reported to be employed under the direction of Henry Bradley, superintendent.

ARIZONA

McCormick Mine Will Produce Lead

Ray Integrity, Yuma, Alpha, McKay, Juno, and Loma Prieta mines to be rehabilitated—Several have RFC loans—Hackberry and Hidden Treasure progressing

▶ George Wright, of Globe, is deepening the shaft on the McCormick mine, near Globe. The property is owned by the Miami Copper Co. Previous production from the property has been manganese, but recently lead ore has been developed below the 50-ft. level, and one shipment has been made. Present plans provide for drifting on the 100-ft. level.

▶ The Ray Integrity mine, west of Ray, which had some production during the first World War, and has been operated occasionally since then, is being reopened by S. O. Phillips, of Ray. The shaft is being unwatered and repaired.

▶ Lessees of the Yuma copper mine, near Vicksburg, have secured an RFC loan for the purpose of rehabilitating the shaft and unwatering the winze in order to resume mining on the sulphide ores which were encountered in these deeper workings. The lessees are Roy MacDonald and George Spry of Wickenburg, and Robert Douglas, of Humboldt. The property is owned by C. H. Waters.

▶ Dr. J. B. Blackwell, of Chloride, has leased his property about a mile from town to Jim Depoe and Elmer Vondriska, both of Chloride. The principal values are in lead and zinc. The property was examined for the vanadium about a year ago.

▶ R. R. Langley, of Los Angeles, was granted an RFC loan of $5,000 recently to be expended in unwatering the 100-ft. shaft and a winze in the main tunnel on the Alpha mine, in Mohave County.

▶ Extensive development work is in progress at the Hackberry mine, near Mayer, which was taken over about a year ago by the Liberty Hill Gold Mines, Ltd. Ores from the Hackberry mine will be treated in the Golden Turkey mill, at Cordes.

▶ Rehabilitating the 300-ft. shaft at the Hidden Treasure mine, in the Black Canyon district of Yavapai County, has passed the halfway mark. An RFC loan of $5,000 was granted recently for this purpose.

▶ The McKay property in the Johnson district, Cochise County, is being reopened by A. H. Warner, of Tucson. The values are principally in copper.

▶ Equipment is being installed at the Juno mine, about a mile west of Chloride. O. E. Andrews, of Chloride, is in charge of the work.

▶ N. Duyn, of Prescott, sub-lessee from Fred Gibbs, of Prescott, is unwatering the shaft on the Loma Prieta mine, owned by Sophia Smoot. Copper and molybdenum in the form of molybdenite have been mined previously from the 400-ft. shaft.

NEW MEXICO

New Fluorspar Mill in Gila Area

Operation of International Mineral & Chemical Corp. will take output of several mines—A.S.&R. at work on Magdalena property

▶E. C. Anderson, of the International Minerals & Chemical Corp., of Chicago, has begun the construction of a new fluorspar mill at Gila for the Metals Reserve Co. The plan contemplates, when completed, a fluorspar mill capable of handling 100 tons every eight hours. To get a quick start, the Horse Shoe mill, at Hillsboro, has been bought and is in the process of being dismantled and moved to the new site. The district around this location—in fact, almost all the western slope of the range in the immediate vicinity—is quite well shot up with sizable deposits of a very good grade of fluorspar which the mill can beneficiate. The present plans are to make a metallurgical grade. At this writing a scale is being installed, an office set up, and personnel hired to begin immediately the stockpiling of fluorspar to be drawn upon as soon as the mill is completed. The output of several fluorspar mines in the vicinity of Gila has been contracted for, and it is anticipated that a large number of mines will soon be furnishing custom ore for this mill. An access road has just been completed to serve the new mill.

▶The International Chemical Co. mill, which was the only fluorspar mill in the entire district, was lately converted to lead and zinc. The company is planning extensive improvement of its plant to take care of the increased demand for milling lead and zinc in the Silver City district. This new project at Gila is a most timely move by the Metals Reserve Co., as the territory for many miles surrounding it is one of the best-known fluorspar districts in New Mexico.

▶American Smelting & Refining Co. has lately purchased the Sherwin-Williams Ozark mine and mill at Magdalena. Underground workings are being dewatered and prepared for production. The office has been staffed temporarily with officials and employees from other A.S.&R. workings. The mill is being overhauled and expanded to increase its capacity so as to relieve the A.S.&R. mill at Hanover. The new program includes the Wooley property at Organ, N. M., which has also been acquired by A.S.&R. Ore from the Wooley mine, which has been shipped to the Hanover mill, will now be diverted to the Magdalena mill for beneficiation; likewise, the ore from the McDonald mine, which has been going to Hanover, will be cared for at Magdalena. A. W. Frolli, of Tucson, is in charge of the operation; H. W. Kaanta, metallurgist in charge of the Hanover mill, is looking after the reconstruction work of the mill, and R. M. Twiss, general office manager of the Ground Hog mine, at Vanadium, is looking after the setting up of the office and personnel.

Here's Another Way to Make Wire Rope Last Longer

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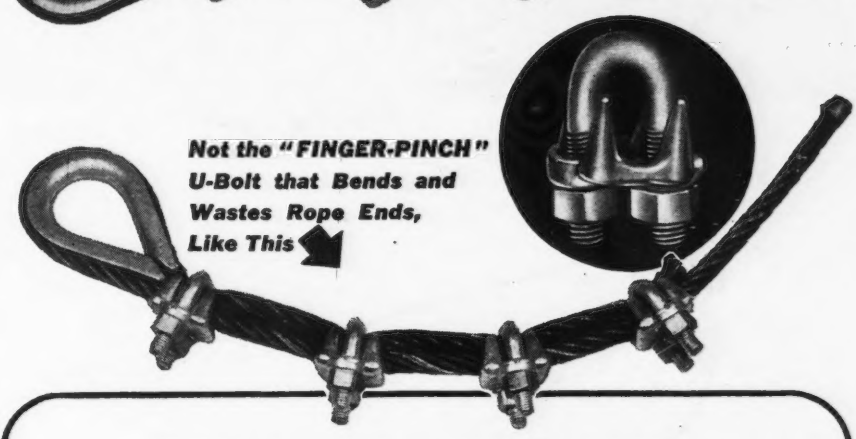

NOTE: The photographs of wire rope assemblies shown here are exact representations of two ¾-inch ropes fitted with recommended number of clips; all nuts on both wires uniformly tightened with indicating wrench. When "Fist-Grip" Clips are used, rope remains straight, whether or not load is applied.

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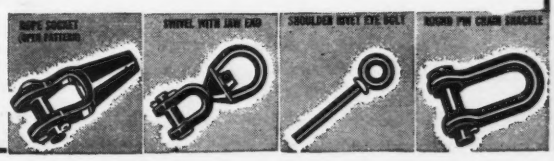
Laughlin "Fist-Grip" Safety Clips distributed Metal & Non-Metallic Mining Catalogs.

ARMY E NAVY



COLORADO

U. S. Vanadium Moves to Grand Junction

Boulder group wants higher tungsten prices—Golden Cycle leases Dives-Pelican properties—New fluorspar mill at Coudry

▶ The old 7-30 mine, at Silver Plume, is to be reopened. The road into the property is being repaired and general preparations are under way to start this property, which is an old producer.

▶ Machinery from both mines (the Illinois and Cross) of the Wolf Tongue Mining Co., near Boulder, is being removed, yet the mill will continue operations on a one-shift basis, receiving custom ore. The Illinois, opened to the 500-ft. level, has been worked continuously by this company since 1936; the Cross, 400 ft. deep, only since 1940. Most of the machinery and manpower are being transferred to the Cold Springs No. 4 mine, 3½ miles northeast of Nederland, according to William Loach, of Boulder, who is vice president and general manager.

▶ The Milliken-Meyers mill, about a mile east of Idaho Springs and now known as the Idaho Springs Custom Mill, Inc., holds a contract with the Metals Reserve Co. authorizing it to certify to premium payments of bonuses due miners on the basis of the lead samples going through the mill. Steps are now being taken to add selective flotation cells to modernize the mill to treat ores from the Idaho Springs mines.

▶ Kenneth Walsh and his son, Thomas M. Walsh, are making plans to develop the Rambler Tungsten mine of the Cowdery mines, by using a bulldozer. At present they are working on the Sunday mine, in this same group. The U. S. Bureau of Mines uncovered tungsten values during its core-drilling program. A 50-ft. shaft and a 50-ft. drift have been run further to develop a vein of tungsten ore.

▶ The United States Bureau of Mines is making a survey of the upper workings of the Red Elephant properties, near Dumont, to determine if the showing will warrant the construction of a trucking road. This property is being developed via new drifts on the Commodore tunnel level.

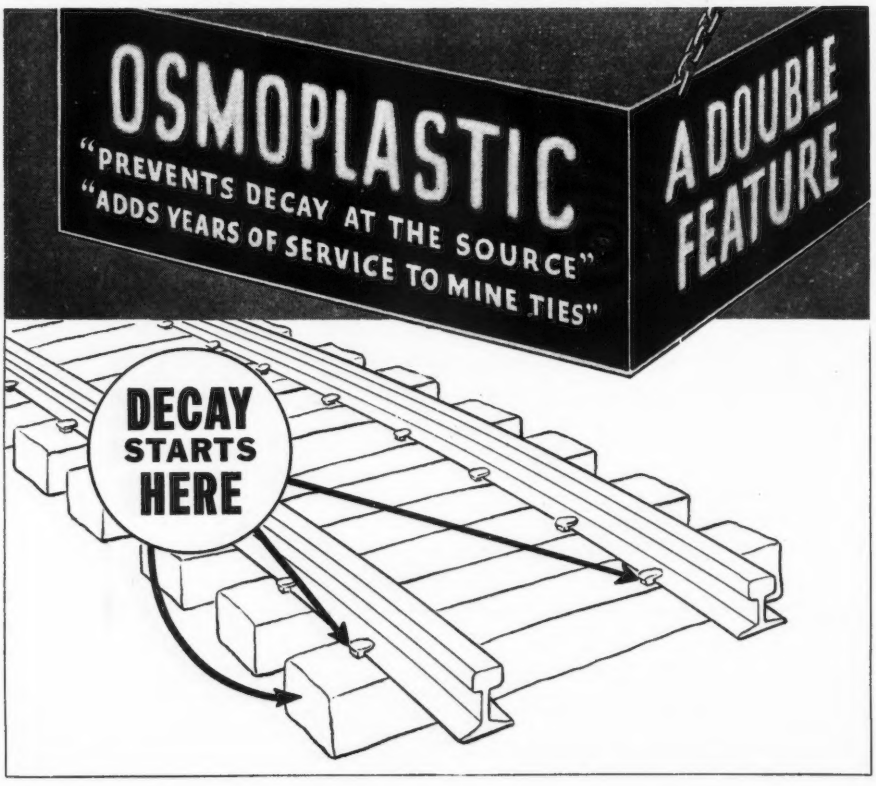
▶ A meeting of tungsten mine owners, leasers, miners, and mill operators was held recently at Boulder for the express purpose of urging Colorado's delegation in Congress to work toward having Boulder designated as a depot for the purchase of tungsten ores, with Salt Lake City prices prevailing. Difference in prices between Boulder and what Metals Reserve pays at Salt Lake City were quoted as $10.50 on 1 percent tungsten, $22.00 on 2 percent, and $32.70 on 3 percent ore.

▶ The Dives-Pelican zinc-lead properties at Silver Plume have been leased by the Golden Cycle Corp., of Colorado Springs; and P. Van Dolah has been appointed superintendent. A. H. Bebee, vice-president of the Golden Cycle Corp. in charge of mining, reports development work will begin immediately.

▶ A $36,458.79 judgment levied against the London Extension Mining Co. by the U. S. District Court in Denver more than a year ago was reversed recently by the U. S. Circuit Court of Appeals. The original judgment awarded half the net profits realized by the mining company from a reworked mine dump to lessors of half the mine. The reversed decision instructed the District Court to enter judgment against the mining company for the $7,300 royalties, representing 20 percent of the net smelter returns on half the material removed from the dump.

▶ The Ore & Chemical Corp.'s sink-and-float mill west of Leadville is three-fourths complete and the crusher building has been practically completed. This mill, being built by the Western Knapp Engineering Co., should be ready for operation by June 15.

▶ The Climax company's production for 1942 was 50 percent greater than for any previous year, and earned a net profit of $13,390,433, or $5.31 a share, after paying increased operating costs and a federal tax of more than $9,700,000. All funded debt having been retired in 1934, the Climax Molybdenum capitalization consists solely of 2,520,000 one-class shares. The company produces from 70 to 85 percent of the world's total annual output of molybdenum, with estimated ore reserves sufficient for 50 years' production. John



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OSMOPLASTIC is a highly economical "ounce of prevention" that is easily applied. Just daub it on where it does the most good...no complicated, expensive methods are required.

Not only does this effective wood preservative treatment add extra years of service life to your mine ties... but to *any* mine timbers that touch other timber or metals or rest against moisture-laden ledges. Bulkheads, timber-sets, car flooring, shafts and tipples, too, will serve you better after you protect them with OSMOPLASTIC.

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R. McCusker, regional director of the War Manpower Commission, has stationed a representative of the commission at Climax to reduce the increasing labor turnover and absenteeism. Selective service is also stationing a representative at the mine to explain to workers of military age their draft status should they fail to comply with the provisions of the stabilization order authorized by President Roosevelt. A white star signifying a renewal award has just been added to the Army-Navy "E" pennant presented to the Climax Molybdenum Co. last September. This is indeed most gratifying, states William J. Coulter, general manager.

▶C. L. Colburn, mining engineer, says that the rehabilitation of the Country Boy zinc mine, two miles from Breckenridge, is progressing satisfactorily, and that the crew of 28 men are working 24 hours per day to get into production. A good vein of high-grade zinc ore was unexpectedly opened up in the upper tunnel, and will add materially to the output of the mine. Shipments to the Golden Cycle Mill began about the middle of May. Samples taken at random from this new body of ore assayed 37.5 percent zinc, 18 oz. silver, a trace of copper, and 4 oz. gold. The lower tunnel has been enlarged to 5x7 in the clear and graded for increased efficiency. New air drills have been added; ore bins built and others repaired, and the road has been cleared of heavy snow. Jack Yaunt is in charge of underground work.

▶According to E. L. Laycock, a ten-year lease on the main workings of the Bull Domingo has been given George D. Parks and George D. Jump, of Boulder. The contract calls for early resumption of unwatering, retimbering, and general reconditioning of the shaft and installation of adequate mining facilities. Mr. Parks is owner and operator of the Ingram and Sunshine gold mines, and Mr. Jump is operating the Jump Mining & Milling Co., now producing a large tonnage of tungsten. The Bull Domingo mine is credited with a $1,000,000 production of zinc, silver, and lead from an ore chimney developed via a 1,000-ft. shaft.

▶The Banner American mill, at Ouray, has established a custom milling business that promises to do much for the production of vitally needed strategic metals. The new sampler service, and acceptance of custom ore in small lots, should result in opening many smaller mines, and as they will continue to handle big outputs, Ouray zinc mining is due for a come-back.

▶Earl E. Crowl, of Denver, having taken a lease and option on the company's properties that include the Gold King and the Gold King Extension adjoining the Sunnyside mines of the United States Smelting, Refining & Mining Co., at Silverton, has resigned as president of the San Juan Gold King Mines, Inc. He also has a lease and option on the Gold Monarch Mining Co. property, the Gold King and Gold Monarch groups comprising about 100 claims. Likewise, he has the Stony Pass group of claims adjoining the Pride of the West group. All of these properties have been important producers, having paid around $3,000,000 in dividends.

Over Fifty Amsco Dippers for Open-Pit Copper Mines

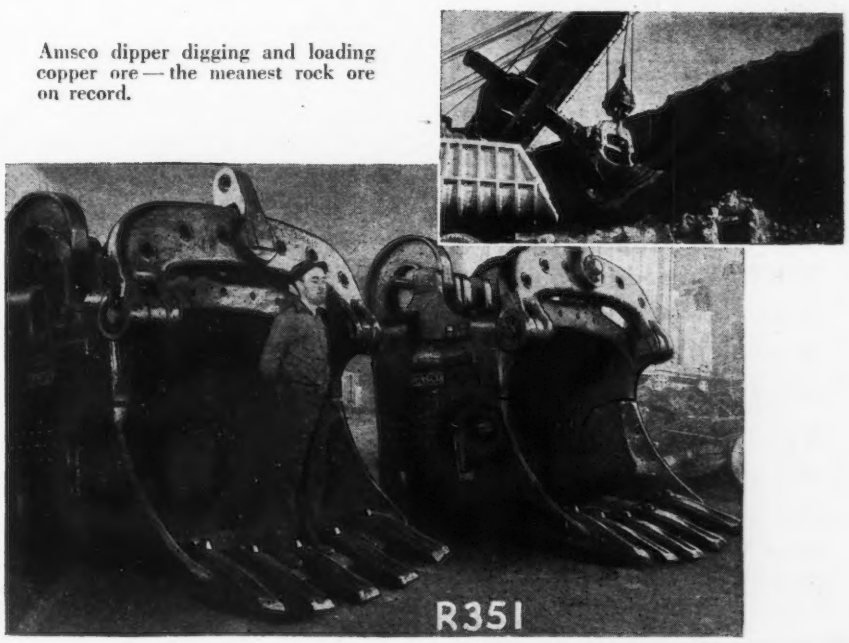
In the open pit copper mines of Arizona and New Mexico, stauncher dippers were necessitated by the adoption of faster, more powerful shovels for stripping overburden and loading ore. The dippers previously used proved inadequate to the severe stresses imposed by the new shovels with their powerful crowd and relatively short booms and dipper sticks.

In 1938, Amsco engineers in close cooperation with the mining operating and maintenance men designed manganese steel renewable lip dippers to cope with the rigorous digging conditions. These dippers had ample strength to resist heavy pressures under speedy operation; sufficient metal at all points of severe abrasion to assure good wearing life; and proper shape to correspond to the short length of the booms and sticks employed. The shape was also influenced by the nature of the digging, height of the bank and the height from which loads were dumped into cars or trucks. Dipper width, lip shape and tooth spacing were designed for filling in short travel, with cutting edges that offered the least possible resistance to digging and filling.

The first Amsco dippers of this design were successful in meeting the difficulties described. To date, over fifty dippers of 4½ and 5 yard capacity of the type shown in view R-351 have been ordered for three open pit copper operations in Arizona and New Mexico. All dippers installed in this field are still in service; and, while fronts, lips and teeth have been replaced because of wear, no failures have occurred from fractures, and all original major parts not subjected to wear are still in service.

If you are interested in reducing dipper replacement and maintenance costs in your mining operations, ask for Bulletin No. 641-D.

Amsco dipper digging and loading copper ore — the meanest rock ore on record.



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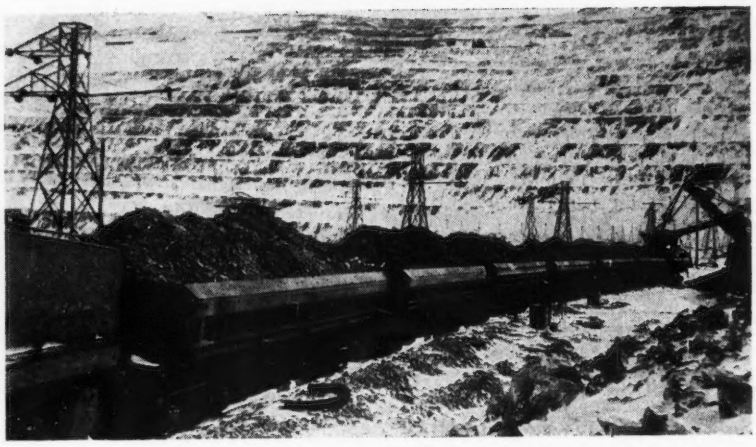

Winter scene in the Bingham pit of Utah Copper Co. Bingham, Utah; loading an ore train

▸COLORADO

and they will be put into operation immediately by Mr. Crowl.

▶ The Durango plant of the U. S. Vanadium Corp. is to be enlarged, according to T. H. Brock, superintendent. The new 100-ton section, which consists of a series of tanks, pumps, etc., is for treatment of tailings and other waste material from the present plant. The transfer of the general offices of the Vanadium Corp. from New York and Chicago to Grand Junction makes it the Western headquarters of the vanadium industry, as a vanadium reduction plant is to be constructed at Grand Junction; likewise, the Uravan plant will be nearly doubled. The U. S. Vanadium Corp. and the government's Metals Reserve Co. are closely aligned in these developments. Blair Burwell is general manager of the Colorado division of the U. S. Vanadium Corp.

▶ E. W. Creel, retiring councilman, has secured the magnesite deposits recently discovered in Box Canyon Park, just outside of the city limits of Ouray, by Robert Wilfley, of Colorado Springs. Mr. Creel has also cleared up the title to the last foot of questioned ground in the park; paid the back taxes on some old and long-abandoned claims considered of no value for many years, and the town will profit to the tune of $1,000 on royalties on ore now in sight. The deposit is from the scores of hot mineral springs in Box Canyon. Though it is a small deposit, it nevertheless is of excellent quality.

▶ Charles O. Parker, prominent mining engineer and assayer, has started a "practical mining for prospectors class" at the Emily Griffith Opportunity School, at Denver.

▶ Leslie Miller, formerly governor of Wyoming, has started erection of a mill at Coudry, for treatment of fluorspar. The heavy-media process will be used, and the construction work is under direction of Jack Ehrholm, superintendent of Western Knapp Engineering Co., of San Francisco. The plant will be completed about July 1, 1943.

UTAH

Operators Air Grievances To Senator Scrugham

Seek more liberal manganese policy, lower taxes, and easing of government regulations—Several companies report financial condition

▶ Representatives of mining companies from Utah, Idaho, Montana, and Colorado met on April 22 at the Hotel Utah, Salt Lake City, to discuss with Senator James G. Scrugham, mines and minerals subcommittee chairman of the Senate's special committee, problems confronting small business enterprises. Assisting Senator Scrugham at the hearing were W. C. Broadgate, Washington, D. C., technical consultant of the Senate subcommittee, and Commissioners Ora Bundy and H. J. Plumhof of the Utah Publicity and Industrial Development Committee. A congressional investigation of individuals in the ferro-alloy branch of the WPB's steel division was asked by A. E. Riley, Colorado representative of manganese producers. Mr. Riley charged that the attitude of the ferro-alloy branch was prejudicial to domestic manganese production. Delegates also asked changes in corporation and individual income tax laws recognizing the hazards involved in mining; easing of securities and exchange commission regulations to facilitate private financing of mining ventures; immedate revision of food rationing to give miners larger allotments, particularly meat; simplification of procedure in getting RFC loans and securing priorities on materials and supplies. The difficulty of getting and keeping miners was stressed as a major problem. Meat rationing was cited as a main issue in this field.

▶ The Park Utah Consolidated Mines Co. reports as the result of 1942 operations net smelter returns of $1,051,192, total income of $1,071,243, and net income before depletion of $95,631. Average grade of the ore was gold, 0.06 oz.; silver, 6.09 oz. per ton; lead, 9.1 per-

cent zinc, 9.36 percent; and copper, 0.29 percent. Unwatering of the Ontario mine and a resumption of operations will open up new sources of ore carrying silver, lead, and zinc.

▶Profits of the New Park Mining Co., at Keetley, increased during 1942 as the result of larger production of copper, lead, and zinc. Total revenue amounted to $1,073,564, a $342,000 increase over 1941, and net operating income before depletion to $384,449, a $183,000 increase. Dividends totaled $199,788.

▶Utah's new leasing law, defining leasers as independent contractors, which took effect on May 11, is expected to stimulate leasing activities, although it is too early to predict how great the benefit will be.

▶The annual report of the National Tunnel & Mines Co., operating from Tooele, in the Bingham district, through the five-mile Elton tunnel, notes an improvement in production as result of connecting the adit with the Utah Apex and Utah Delaware mines in Bingham. A large amount of reconditioning work was done in workings filled with water for years, and production increased to 67,519 tons carrying 2,052,750 lb. of copper; 619,433 lb. of lead; 210,512 lb. of zinc; and 779 oz. of gold. Total operating income amounted to $320,882, which was offset by development costs and Elton tunnel amortization charges amounting to $953,361.

MONTANA

Large Chromite Mill Now Operating

Old Britannia manganese mine being reopened—New manganese shipper in Meagher County—Boaz mine developing new level

▶Peter Antonioli and associates, of Butte, are reopening the old Britannia mine, south of Butte, in a search for manganese ore. The Britannia, an early-day producer of silver ore, has been idle for many years. A new headframe has been erected, and the first 180 ft. of the 400-ft. shaft have been cleaned out and repaired. Equipment installed includes an electrically powered hoist, an air compressor, and a ventilation fan. Four men are employed repairing the shaft.

▶Lessees are making occasional shipments of high-grade lead ore from the Dandy lead mine, 5 miles south of Radersburg, in Broadwater County. The last carload shipped is said to have assayed 45 percent lead. The Dandy mine is owned by Butte Copper Consolidated Mines, of Butte. Carl J. Trauerman is vice president and consulting engineer for the company.

▶Test runs for the new 3,000-ton capacity chromite concentrator at the Mouat mine, in Stillwater County, began on May 1. The concentrator went into full-scale operation during the second week in May, milling chromite ore from the Mouat mine, on the Stillwater River. Construction work on the concentrator

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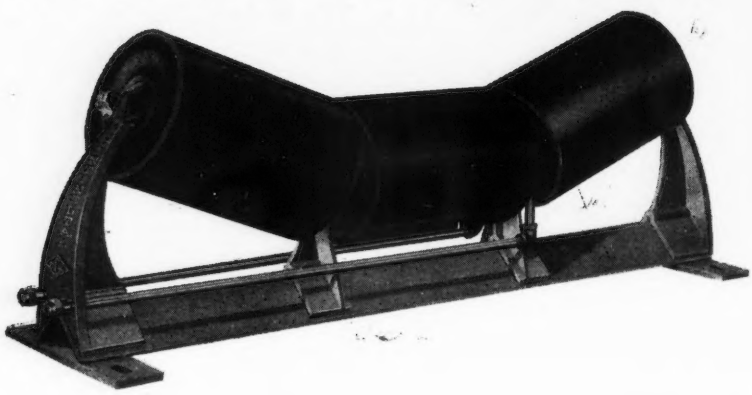

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▶MONTANA

was started by the Anaconda Copper Mining Co. a little more than a year ago, and the mine has been under development for a somewhat longer period. Mine and mill are operated by Anaconda under a management agreement with the Defense Plant Corp.

▶A. Burns, of Butte, is prospecting a surface concentration of black manganese oxide 30 miles northwest of White Sulphur Springs, in Meagher County. Burns reports that he has contracted to ship 1,000 tons of the ore to the Metals Reserve Co.'s stockpile in Butte and expects to begin shipping in June. Trench sampling done to date indicates a manganese content in the deposit ranging from 25 to 40 percent. Mining will be a small-scale open-pit operation.

▶The main winze in the Boaz mine is being sunk from the 600 to the 700 level. Sinking operations began May 1. The Boaz mine, near Norris, in Madison County, has been in continuous production of lead and gold ore since 1934. Ore for the 35-ton-capacity concentration and cyanidation mill is currently coming from the 500 and 600 levels of the mine. The mill products are a high-grade galena-pyrite concentrate containing gold and silver that is shipped to the American Smelting & Refining Co., and gold and silver bricks from the cyanidation unit refinery that are shipped to the U. S. Mint. The Boaz vein is in a steeply dipping fissure cutting the Pony gneiss. The mine has been developed via a vertical shaft to the 500-ft. level and a winze in the vein from the 500 to the 600 level. It is expected that the new 700-ft. level will be opened up by midsummer. K. D. Lynn is manager of the Boaz mine, and John Hughes is mine foreman.

ALASKA

Several Dredge Operations Are Resuming

U. S. Smelting will mark time this season —Maps available of zinc deposits in Wrangell district—Several mineral surveys are planned

▶Hereafter, permission for the operation of gold placer mines using less than five men may be secured from the Commissioner of Mines, at Juneau, according to B. D. Stewart, the commissioner. Heretofore, this permission has been granted only by the War Production Board at Washington.

▶Walter Fisher is profiting by the smallness of his operations. He is conducting gold mining on Grants Creek, 30 miles below Fort Gibbons. He employs only four men and uses a dragline and bulldozer.

▶Adolph Boch has returned to the Manley Hot Springs district, where he will continue this season to conduct placer operations for tin. He has received government approval.

▶ Roy B. Earling, general manager of United States Smelting, Refining & Mining Co., says only 15 or 20 men will be employed this season—just enough to care for the dredges, thawing equipment and stripping equipment, and to maintain a small flow of water to prevent damage that might be caused if they were shut down. Only men over 55 will be employed and none engaged in any work directly or indirectly connected with the war effort will be used. The company's shops, its garage and part of its office buildings, and several houses are under lease to the Northwest Service Command and its district engineer. Equipment will be kept in good condition.

▶ Harold Heide, of the U. S. Bureau of Mines, has returned to supervise for another season tin operations on the Seward Peninsula. Norman Ebbley, Jr., engineer for the bureau, has returned to Fairbanks to superintend work being done in the interior.

▶ Eight men are putting the plant of Holbrook Dredging Co. in condition for this season's operation on Sixtymile. John R. Fraser is in charge for the receiver. It is said the company has many years of workable ground ahead.

▶ Henry R. Joesting, with the Alaska Territorial Department of Mines, says a second report on strategic mineral occurrences will soon be published by the Territorial Department. A similar report was made in 1942. Descriptions of strategic mineral deposits which warrant further prospecting will be given, as well as reports on the activities of various government agencies.

▶ Swanson, Seaholm, and Lunde will continue operations in Dublin Gulch, in the Mayo district, where they opened scheelite deposits last year. They are getting government assistance, and the Territory has placed at their disposal a large bulldozer. Haggart Creek Mining Co. was forced to suspend operations on Dublin Gulch last season because of inability to secure experienced men.

▶ Howard Sparks and two assistants have spent the winter building a 50-mile road from Kansas Creek to Birch Lake, on the Richardson Highway. This summer they will mine and sack antimony ore, which will be taken into Fairbanks after the freeze-up next fall.

▶ The U. S. Geological Survey has examined zinc deposits in Groundhog Basin, in the Wrangell district of southeastern Alaska. Preliminary maps have been prepared, showing surface exposures and short tunnels. Photostat copies are available.

▶ Alaska Department of Mines this season will continue the detailed survey of tungsten deposits in the Fairbanks district started last year and will make a survey of mineral deposits between the Sawtooth Mountains and Roughtop Mountain. Dr. H. R. Joesting will be in charge, and Kenneth Wier, senior in mining at the University of Alaska, will assist.

▶ Goodnews Bay Mining Co. has resumed operations at Platinum, employing about 65 men, two drills and hydraulic equipment, and a dredge and dragline. Ed Olson is superintendent.

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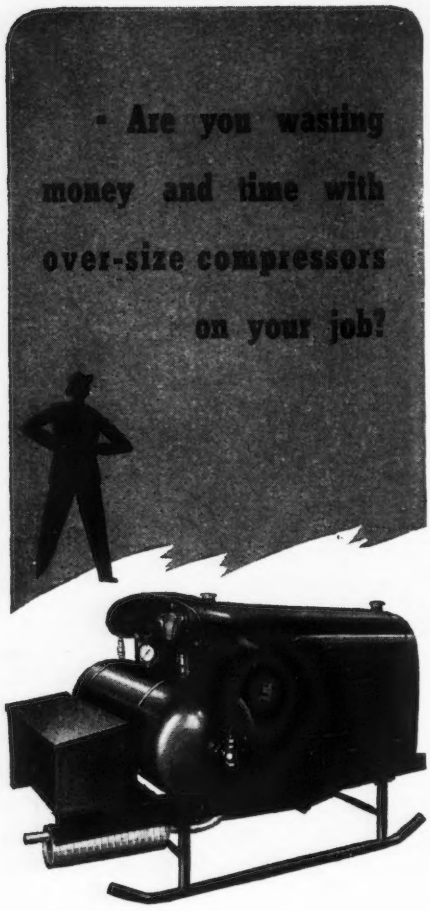

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IDAHO

New Orebody Found In Polaris Mines

Hecla tailings plant near completion—New road planned for fluorspar shipments—Clayton mine developing rich oreshoot

▶ Official figures compiled from sworn statements filed with the county assessor by mining companies of the Coeur d'Alene district gave a total of gross net profits from production in 1942 of $8,441,236. This total compares favorably with $8,472,594 in 1941 and $8,013,619 in 1940. The list filed this year includes 15 major producers. Production during 1942 in the district amounted to 2,276,218 tons. The gross value of this tonnage was reported as $34,348,160. Cost of mining this ore was $14,703,008, the greater part of which went to labor. The freight and treatment charges, shared by the railroads and smelters, totaled $10,380,463. Production was far below what it would have been had miners been available. Most of the large companies had to curtail production for a large part of the year because of labor shortage, the district being short more than 1,000 miners a greater part of the time.

▶ Hecla Mining Co., of Wallace, at its annual meeting in May, declared a dividend of $250,000, at the rate of 25c. per share. This is the second dividend of similar amount paid this year. President L. E. Hanley reported a new discovery of high-grade ore in the Polaris mine, controlled by the Hecla. The new ore was in a crosscut from a drift which the Sunshine company is driving into Polaris ground from the 2,700 Sunshine level, and is thought by engineers to be the Chester vein. The ore is a high-grade galena, assaying 74 percent lead and 145 oz. silver. Where opened in the crosscut the ore is 10 in. wide. Drifts will be extended along the vein to determine the extent of the oreshoot. President Hanley reported that the Hecla's new sink-and-float tailings plant at Osburn is nearing completion and should be ready for production by June 1. This plant is designed to handle 1,000 tons a day from a tailings deposit along the Coeur d'Alene River estimated at 1,500,000 tons, accumulated over the past 40 years of mining operations by major producers 10 to 15 miles above the deposit. The sink-and-float plant will discard about 40 percent of the waste material and produce a zinc-lead mill feed, which will be treated at the Hecla and Polaris mills.

▶ The public roads administration has approved the building of a road from Myers Creek westward down Camas Creek, near Salmon City, in eastern Idaho, for the purpose of shipping 10,000 tons of fluorspar rock from newly discovered deposits in that region. The forestry service has completed the survey and will construct the road.

▶ The Camas mine, near Hailey, in the Wood River district, will soon be in steady production, according to Frank Plughoff, superintendent. Two miles of new road have been completed and an electric power line has been built to the property. Machinery for the mining operations was purchased from the Minnie Moore mine, in the same district. Copper and lead are the chief values. Stoping will start on the 300-shaft level.

▶ Three properties in the Coeur d'Alenes controlled by the Day interests have declared semiannual dividends. The Tamarack & Custer dividend amounts to 3c. a share and totals $150,000. The Sherman Lead Co. paid 2c. for a total of $73,500 and the Dayrock disbursed 2c. per share for a total of $34,943.

▶ Directors of the Clayton Silver Mines, operating in eastern Idaho, near Clayton, have declared a dividend of $45,000, or 1½c. per share. This is the company's third dividend, having paid two in 1942 totaling $105,000. William Yeaman, of Yakima, Wash., is president of the corporation, and C. A. Fay, general manager. Manager Fay reported to the directors that a large shoot of high-grade ore had been developed on the 300 level, where the vein is 10 ft. wide, averaging 5.8 percent lead and 7.7 oz. silver per ton. In places the vein is reported to be 26 ft. in width of minable ore. The property is equipped with a mill of 110 tons' daily capacity and is operating on a 7-day basis. The

concentrates are hauled 60 miles by truck to Mackay, the nearest railhead. The company operates its own fleet of heavy-duty trucks.

▶The Sidney Mining Co., operating in the Pine Creek district of the Coeur d'Alenes, is now milling 50 tons of zinc-lead ore daily, according to W. T. Simons, secretary, of Kellogg.

OREGON

New Aluminum Plant Is Contemplated

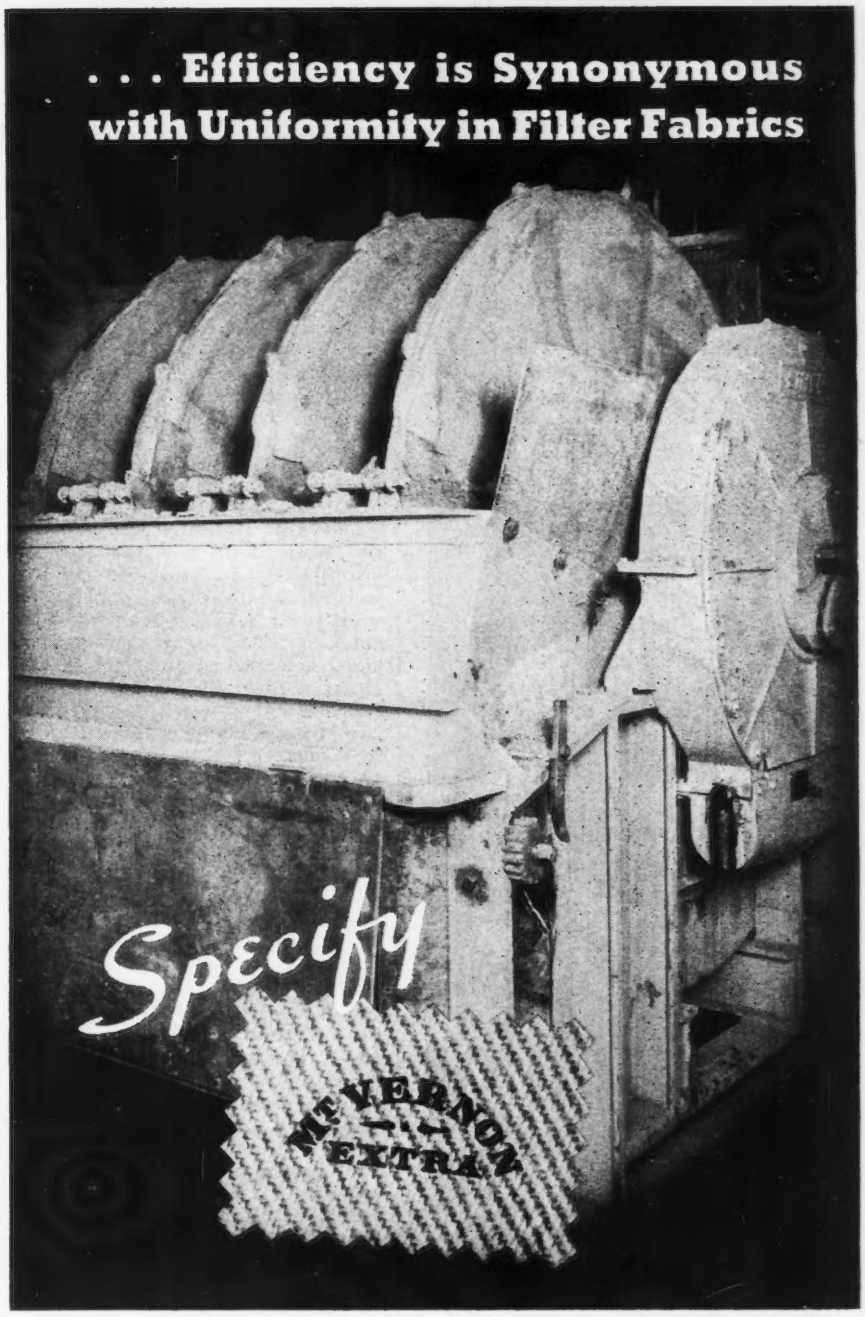
Has been designed to process Oregon clays—Possible magnesium ore in Douglas County—Two miners killed by monoxide

▶WPB is expected to authorize construction of a pilot plant to manufacture alumina from clays in western Oregon. Columbia Light Metals Corp., a syndicate of Portland, Tacoma, and Seattle men, is the probable builder of the plant. The plant's capacity is given at 100 to 150 tons of alumina a day. Troutdale, Oregon, is the expected location, although towns in Washington are also asking for it. All are easily within reach of Bonneville power.

▶The Oregon Department of Geology and Mineral Industries reports large masses of peridotite and serpentine containing 40 to 45 percent magnesium oxide in the Nickel Mountain region, in southern Douglas County. The district is tributary to Bonneville power and is served by the Southern Pacific Railroad.

▶Martin Cozink and Joab G. Rice, miners, were drowned in the old Sanger mine, in Baker County, several weeks ago. A man living in a cabin near by missed the two and reported to the sheriff, who described the peculiar accident which had occurred. A bucket operated on a track into the mine by a gasoline motor had overturned below the surface of the water which had filled the main shaft. The searchers started the motor, pulled out the bucket, filled it with rocks to keep it upright, and sent it down into the water. When they pulled the bucket out, suction brought the body of Cozink to the surface. Rice's body was not recovered for four days until a crew pumped the shaft dry. The coroner reported that monoxide exhaust gas from the engine was conveyed into the mine shaft through the compressor, causing the death of the two men, and that later the mine filled with water.

▶No significant amount of beryllium was found by the State Department of Geology and Mineral Industries in representative samples obtained from the deposit reported recently as a new discovery of beryllium ore in Jackson County. Spectrographic and chemical analyses of several samples of the rock gave results ranging from 0.001 to 0.002% beryllium oxide—an amount too small to be classed other than as a trace. The rock is classified as an altered volcanic tuff or breccia, made up of fragments thrown out by volcanic activity. Samples contain secondary quartz and chalcedony. No beryllium could be found microscopically.



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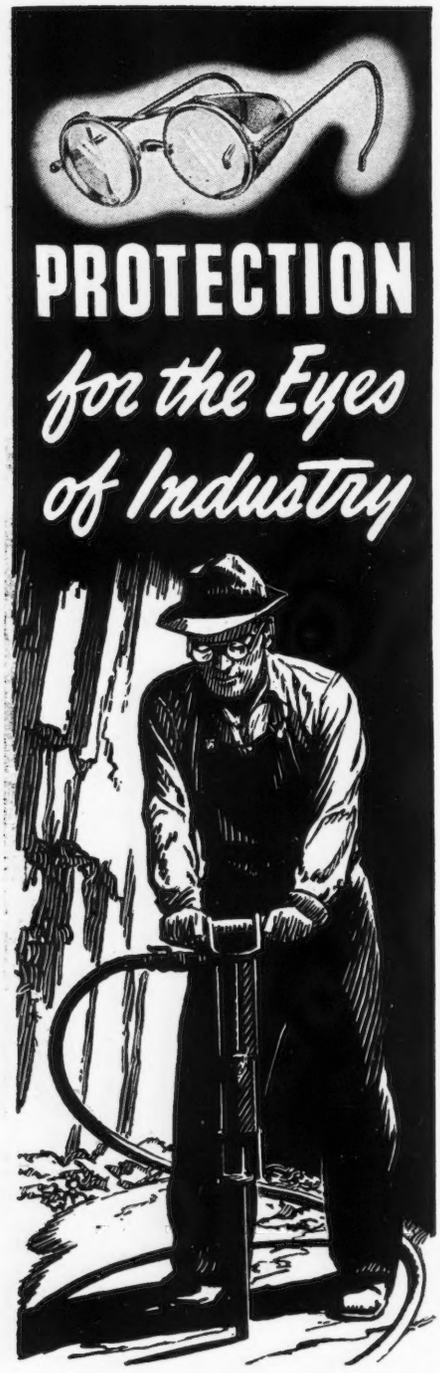

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WASHINGTON

Bonneville Power May Go To Stevens County

Gorrien property has proven ore—Metaline district is very active—General Electric leases Germania mine

▶ Dr. Paul Raver, Bonneville Power administrator, in addressing the Colville Kiwanis Club, assured the mining men of northern Stevens County that power will be extended to the mining operations in that region whenever there is sufficient need and as soon as government agencies authorize the priorities which will be needed to secure material for power-line construction. He and members of his staff spent two days in the area. It is said that substantial quantities of lead and zinc will be provided from the mines of this district when power is available. Operations have obtained what power they could from diesel engines and from the Northport Power & Light Co. That corporation is supplied with power by the West Kootenay Power & Light Co., of Nelson, which says, however, that it cannot increase the load. Among the operations said to be in the market for this power, when available, are Sierra Zinc Co., the Willow Creek Mining Co., and mines in the Gladstone and Red Top mountain districts.

▶ Willow Creek Mining Co. is the new corporation which has taken over the old Gorrien property, four miles east of Northport. It has secured assistance from RFC for the construction of a 200-ton mill at a cost estimated above $60,000. This is the biggest new mining project in northern Stevens County. At the head of the enterprise is Frank H. Mitchell, manager of the Knob Hill mine, at Republic. Stuart & Brown, of San Francisco, are associated in the enterprise. They acquired the property last fall and conducted diamond-drill exploration through the winter. It is said the drills discovered 60,000 tons of good ore, which will run not less than 8 to 12 percent zinc, according to mining men familiar with the property.

▶ The Metaline mining district, in northeastern Washington, is experiencing its greatest activity in years. In anticipation of the demand for living quarters, the American Zinc, Lead & Smelting Co. has applied to the Defense Housing Agency for the construction of 200 houses for workmen of Metaline Mining & Leasing Co., the American Zinc subsidiary. The flume of the Lehigh Portland Cement Co. burst several weeks ago. Part of the power created by the Lehigh company went to Metaline Leasing Co., which was forced to close its Grandview mill. This power is being restored and in addition the Metaline Leasing Co. is installing two diesel engines, which will give it ample power and enable it to increase its production beyond what it has ever been. More than 400 men will be employed by Metaline Mining & Leasing Co. and by Pend Oreille Mines & Metals Co. Grandview Mines Co., operated by Metaline Mining & Leasing Co., reports that it has now secured patents on all its mining claims. Some of these patents were held in abeyance for more than 25 years since Hugh Cooper was attempting to develop power at Z Canyon on the Pend Oreille River below Metaline Falls.

▶ A. E. Torelle, of Spokane, is arranging to develop the old Coffin claims west of Ione, which he holds under lease.

▶ Royal Development Co. claims that an odd error was made by the county assessor of Chelan County. The company claims that the assessed value of its mining property was intended to be $48,460 but that a figure "1" was by mistake placed in front of the number. The property is one of the oldest copper mines in central Washington. It is near Leavenworth. The company has brought suit asking for an adjustment.

▶ General Electric Co. has leased its Germania mine, in southwestern Stevens County, to two prospectors. Practically all the equipment has been sold. This has been a million dollar tungsten producer.

▶ Government engineers have been surveying extensive areas east of Spokane in quest of potential aluminum deposits. Engineers from the University of Idaho have been assisting.

▶ Ward Carithers, of the State Division of Mines, spent several days in May examining the Bowman lead property on Stepstone Creek near Nespelem, and the Congress mine, on Manila Creek, and was particularly interested in nickel showings in those districts.

▶ Ten carloads of dolomite from the quarry at Marble, in Stevens County, are being shipped daily for magnesium production, according to O. W. Gravely, of the Electro-Metallurgical Co.

▶ J. F. Haight, superintendent of the aluminum rolling mills, said in a public meeting of Northwest Mining Association on May 17 that the Washington plants of the Aluminum Company of America have been in production several weeks fabricating sheets and plates for aircraft construction. The bauxite used in the plants comes from Arkansas, he said, and is not quite so good as foreign bauxite, but the latter is not now available. Methods of extracting aluminum from the extensive clay beds near Spokane may later be developed. The rolling mill is said to be the most perfect and complete in the world.

Release Tungsten to Save Molybdenum

PURCHASE AND PRODUCTION of a greater amount of tungsten high-speed steel than previously permitted have been authorized by the War Production Board to accomplish necessary savings in current use of molybdenum. Under Order M-21-h as amended May 10, tungsten-type high-speed steels may be produced and purchased up to 35 percent of the production of the total high-speed steel. Previously, the tungsten-type production was limited to 25 percent of the total high-speed steel.

TRI-STATE

Record Flood Arrests Production Temporarily

Cardin and Oronogo areas worst hit—West Side mill shuts down—Bureau starts dewatering Melrose area

▶ Unprecedented floods hit the Tri-State mining district during the next to the last week of May. Floods and the shutting down for a 3½-day period of the steam-generating electric power plant of the Empire District Electric Co. at Riverton, Kan., by the 87-year high-water mark of Spring River, caused the suspension in the district of all mining and milling operations for the greater part of a week. Production of zinc and lead concentrates in the local mining field was off several thousand tons for the week, and it was estimated that the loss for May would range from one-fourth to one-third of the recent average monthly rate. Rainfall, totaling 15.56 inches, was recorded at Joplin for a three-day period—May 17, 18, and 19—during which approximately 7,000 mine and mill employees were thrown out of work. Flood damages and the expense of heavy pumping at a number of properties is expected up into six figures.

▶ Due to the flooding of the underground working levels of several mines throughout the district, production was expected to continue sub-normal for weeks, or even months, depending on the progress in dewatering the flooded mines and the speed of rehabilitating damaged equipment and property. Among the mines hardest hit by flooding were those of the Eagle-Picher M. & S. Co. in Section 30 of the Oklahoma field, south of Cardin. Swollen waters from the converging Tar and Lytle creeks broke through a dike at a cave-in on the Woodchuck lease and spilled into the underground workings of the Weidman Mining Co. H. W. Harrison, of Miami, general superintendent at the Eagle-Picher Cardin field offices, reported that a stream of water, approximately 50 feet wide and two feet deep, ran into the cave-in for a period of more than eight hours before the creeks receded. From the Woodchuck mine and through the See Sah property the waters dropped to the lower depths of the Eagle-Picher Hum-bah-wah-tah Nos. 1, 2, and 3; Blue Goose 1 and 2, and the Southside mines, flooding them to a depth of from 5 to 15 feet over 100 acres of underground workings, according to G. C. Niday, of Miami, Tri-State manager of mines and mills for the company. The company immediately began the installation of large turbine pumps at the old Jay Bird and Hum-bah-wah-tah No. 2 shafts to dewater the flooded area, which was expected to require from 10 days to two weeks, Harrison said. According to S. S. Clarke, of Miami, general mine superintendent for the company, two 10-in. turbine pumps were installed at the Jay Bird and another pump was installed at the Hum-bah-wah-tah. A 14-in. turbine pump from the Oronogo field was installed later at the Hum-bah-wah-tah, and another 10-in. pump ordered for the emergency out of St. Louis was installed at one of the Southside mine shafts.

▶ With the exception of Eagle-Picher properties, almost 100 percent of the Picher field was ready to go back into production before the end of the month. Surpassing the flood of April, 1941, Center Creek established an all-time flood crest not only to fill mines in the Oronogo bottoms, but to overflow into old underground workings of the Webb City field. Water stood at a depth of 175 feet above the lowest working level of 220 feet in the famous open-pit mine at Oronogo, was about 20 ft. from the collar of the Steel shaft, and less than 15 ft. at the Waring No. 5, on the north edge of the Oronogo bottoms, according to Frank Fenix, of Joplin. Prior to the flooding, the Oronogo Mutual Mining Co. moved its power shovels and other equipment to the surface from its open-pit min, but Fenix & Sons were unable to remove several thousand dollars' worth of mining equipment from underground nearby. A large turbine pump of the Eagle-Picher company in the Skinner shaft, south of Center Creek, was damaged badly when its supports gave way and it dropped into the shaft. The supports gave way when a huge column of water gushed forth from the shaft. All shafts in the flooded bottoms were filled to their collars.

▶ The pump situation is being surveyed preparatory to inaugurating the expensive undertaking of dewatering the Oronogo area, but no definite plans have

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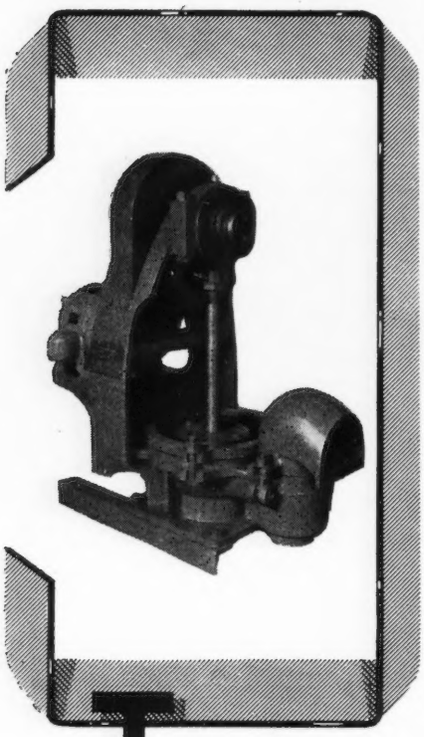

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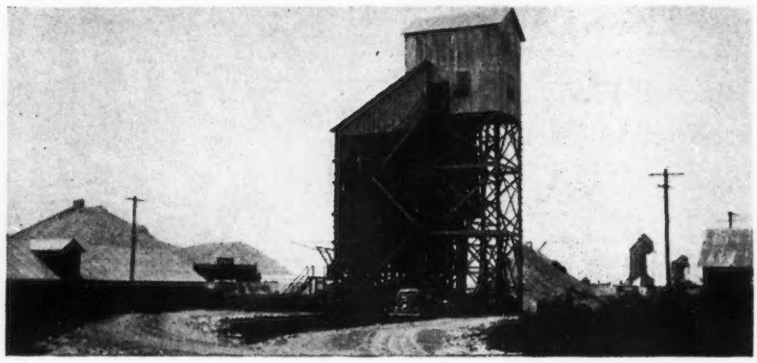


Derrick and hopper of new shaft of Dines Mining Co. on Douthat land near Cardin, Okla.

▶TRI-STATE

as yet been announced. Other mines in the district flooded, or which received heavy inflows underground, included those at Galena, Baxter Springs, Waco, Wentworth, Thoms Station, Chitwood, Granby, Duenweg, Stotts City, and Lincolnville. Damage to surface railroads —including N.E.O. and Frisco lines serving the mining field—and roadways were extensive, due to washouts. Considerable trackage underground also was uprooted and twisted. Collars of several shafts caved, or the cribbing buckled. Prospects and gouges of many small operators throughout the district were drowned out, and it probably will be weeks before they will be reopened.

▶During their crest principal streams blocked major highways of the district, isolating the leading towns and cities in two or more directions, including Miami, Picher, Baxter Springs, and Joplin.

▶During the middle of the month the Eagle-Picher company shut down its West Side mill, formerly the old Vinegar Hill Barr, marking the passing of another important landmark in the north part of the Picher field within a six-month period. The old Commerce Webber mill, on an adjoining lease to the west, was closed early last November. With the closing of the West Side mill, G. C. Niday, of Miami, Tri-State operating manager for the company, said that ore from the formerly-rich 60-acre Barr lease was being shifted to the company's Central mill for treatment. A railroad extension from an N.E.O. spur was laid to the old Barr storage hopper, and a hopper chute was installed to facilitate direct loading of ore into railroad cars and subsequent haulage to the big mill. The new arrangement for handling and treating the low-grade ores from the old property, which has been a rich producer of zinc and lead concentrates the last quarter-century, will make for a more economical operation, Niday said.

▶Capacity of the Youngman Milling Co.'s concentration plant on the old Robinson lease, a mile northwest of Treece, is being increased from 20 to 50 tons of ore an hour, according to Harold Youngman, of Baxter Springs. The company has entered into a contract with the Federal Mining & Smelting Co. for the hauling and treatment of ore from the last-named company's mine properties in the Kansas section of the Picher field, which is the principal reason for expanding the milling capacity of the plant, Youngman said.

▶C. C. Knox, of Joplin, project engineer, reported that the U. S. Bureau of Mines started the dewatering of the Park-Walton lease, three miles southwest of Melrose, Kan., during the first week of May. Two large Pomona turbine pumps, with 9-in. discharges capable of handling 1,500 g.p.m. from a depth of 300 ft., have been installed and placed in operation, and third pump of the same size has arrived for installation. The pump heads feature direct-connected 2,300-volt, 60 cycles, 150 hp. electric motors. The pump columns were installed in large drill holes put down about a year ago on the lease by the United Zinc Smelting Corp., which holds the Park-Walton and other acreage in the area, and which probably will sink one or more shafts.

▶Harris Mining Co. is sinking a new shaft on the northeast forty of the old Evans-Wallower No. 24 lease, northeast of Picher, in Kansas. The shaft will be put down to a depth of 240 ft., according to Loren Keenan, of Baxter Springs, company superintendent. The company now is mining from the southeast shaft on the 160-acre lease, from which ore is trucked to the Youngman mill, northwest of Treece, for treatment.

▶Bilwil Mining Co. has dewatered, reopened, and now is hoisting ore, at the old Ebenstein mill shaft, a mile northwest of Baxter Springs. Ore is being trucked to the Blue Mound mill of the Dines Mining Co., north of Picher, in Kansas. Approximately three months were required to dewater the shaft, which was last operated by the old Chanute Smelter Co., a subsidiary of the American Metal Co., Ltd., about a score of years ago. Mine operations are being carried on around the 247-ft. level.

▶S., H. & D. Mining Co. has reopened the old field shaft on the Montreal lease at Douthat, according to W. H. Stone, of Picher. Mine operations are being carried on at the 220-ft. level. Associated with Stone are John S. Henderson, of Cardin, and William Dunn, of Kansas City.

ARKANSAS

Bureau Expanding Bauxite Exploration Program

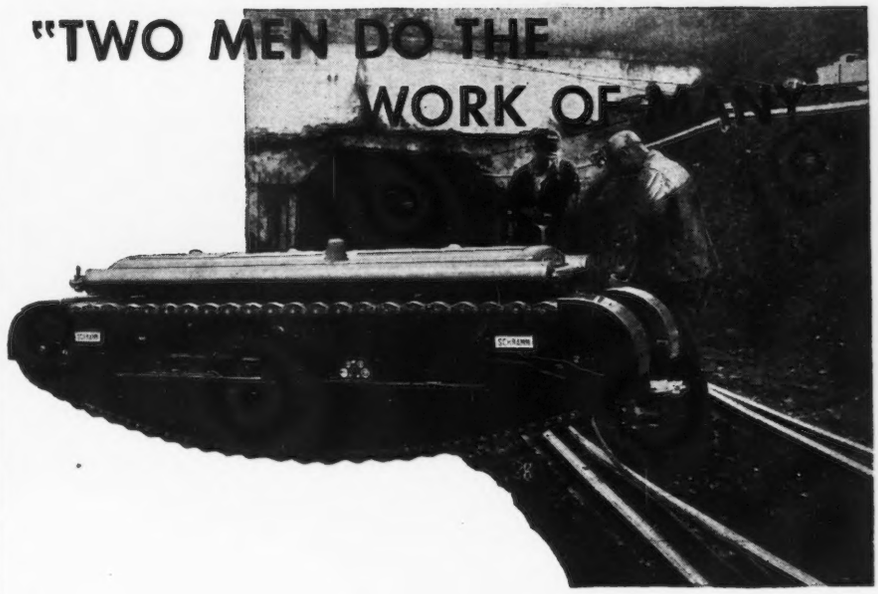
Quartz crystal development said to be promising—May develop market for sintered manganese ore—Hurricane zinc mine development is encouraging

▶According to J. R. Thoenen, district engineer of the Bureau of Mines in charge of Arkansas developments, an expanded program of bauxite exploration will be started immediately. Contracts have been made for 13 new churn-drill rigs, which will bring the total to 20. To handle this additional load, the field force of the Bureau will probably be doubled to include 25 engineers, 25 laboratory chemists and technicians, and 60 to 70 miscellaneous personnel. Thoenen also announced that a 16-in. core drill for sampling low-grade bauxite ore has been put into operation. It was also announced that Bureau engineers have recommended development work on a mica deposit in Hot Springs County, presumably a pegmatite.

▶Announcement has been made that the Federal Public Housing Authority project at Pine Haven to house bauxite miners and processing plant workers will have retail stores of various kinds, and a bank, all of which will be under the supervision of Robert Johnson, of FPHA.

▶Metals Reserve Co. now has 45 workmen engaged in development work in the search for quartz crystals in the Hot Springs area. Adits are being driven in Fisher Mountain, in Montgomery County, and Miller Mountain, in Garland County. According to Charles W. Plumb, MRC agent in charge of the work, preliminary development work has uncovered a number of usable crystals.

▶Production of low-grade manganese ore in the Batesville-Cushman manganese field has practically stopped, as Metals Reserve discontinued the purchase of this grade of ore the last of March. Production of high-grade ore since that time has shown a big gain. During April, the field produced approximately 575 tons of high grade, and if plans of several operators work out successfully, production of high grade will show a substantial increase during the next few months. A washing, screening, and sintering process is being worked out for low grade wad, and calcining is being tested now to beneficiate low-grade carbonates. The final outcome of these experiments cannot be foretold at this time, but apparently they will be successful. Sintered wad ore is well adapted to blast-furnace use, and there is a strong demand for it. A representative from a new blast furnace in Texas was in the field late in April, checking the carbonate deposits and possible production. He was satisfied with what he saw, and a new market for this class ore may be opened up. Lime is used as a flux in a blast-furnace mix. Arkansas carbonates carry a large percentage of lime, and this ore will supply



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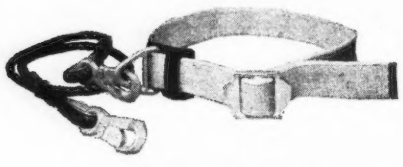

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EVERYTHING BULLARD IN SAFETY

▶ARKANSAS

both the manganese and the lime for blast-furnace purposes.

▶ McGee and Little, of Batesville, who operate the Gray Hill and Stark Spring properties, have been experimenting with the sintering process for several months, and are erecting a plant in Batesville. It will be fired with natural gas.

▶ The Par-Mar, operating the Bone Cave Hollow and Lafferty Creek properties, is completing the largest washing and concentrating plant ever erected in the field, on its Lafferty Creek holdings. It will handle 100 tons of crude an hour. Mining operations on this property are carried on with two large hydraulic nozzles, which move approximately 100 tons of ore-bearing dirt an hour. The chunk ore is marketable as it comes from the ground. The fines, which are mixed with more or less foreign matter, will be run through the new plant. The company has sold 50 tons of high-grade recently to Metals Reserve, which still retains a high-grade market at Batesville, that ran 58.90, which was one of the highest-grade lots ever sold in the field. The E. & A., operating on the Bayou, near Batesville, is also mining with hydraulic nozzles. It started out with one, and is now installing another pumping unit. James Wood, of Batesville, is operating engineer for both concerns. Stanley Hanford, is superintendent of Par-Mar.

▶ Consolidated Mining Co., headed by Dr. Hoxsey, of Batesville, produced 40 tons of high grade during April. It operates the Chin and other mines in the Cave Creek district. Because of the death of Dr. F. W. Zipfel, in April, its properties are now shut down. Dr. Hoxsey states that the company will have them in operation again soon.

▶ V. C. Johnson, well-known quarryman of Little Rock, is now operating on the Southern Hill property, near Cushman, with a large power shovel. During the last 30 days he has driven one large open cut 300 ft. long and 29 ft. deep around the edge of a hill, cutting into the ore-bearing formation.

▶ Southern Manganese & Mining Co., headed by Herman Miller and Berry Fitzgerald, of Batesville, is now assembling equipment for the installation of a large washing and milling plant on the Bayou near Cushman. It has been operating a small pilot plant there for several months. The new plant will carry about 18 jig cells. The company operates the Polk-Southard mine, near Cushman.

▶ Zinc mining during the last 30 days has made slight gains in the North Arkansas zinc and lead field. Three mills are in operation. Twenty-seven were in operation during the first World War. Most of them during that period operated on zinc silicate and carbonate ores, for which there was a strong demand, and the price ran as high as $85 per ton. The same type ores now bring around $40 a ton, and unless they are produced in large tonnage the demand is very weak.

▶ After eight months of development work and installation of equipment, the Silver Hollow Mining Co., operating the Silver Hollow and Silver Queen mines, in the Rush district, in Marion County, is now in production. Operations at this time are confined to the Silver Hollow mine, which is on Buffalo River, a mile and a half below the mouth of Rush Creek. Milling operations are carried on at the Edith mill.

▶ J. C. Shepherd, of Harrison, Ark., in charge of operations for the Hurricane Mining Co., operating the Hurricane mine, near Pindall, in Searcy County, is sinking his third test shaft in the St. Joe fault, which runs across the property. The new shaft has reached a depth of 40 ft., but is not yet down to the ore run. He sank the other two to a depth of 70 ft., encountered good veins of carbonate, and ran cross drifts through the ore across the fault. After enough ore is definitely proved, a mill will be probably installed on the property.

▶ The Excelsior Mining Co. operations, in charge of Doyle Palmer, of Harrison, now has its property, the Excelsior mine, near St. Joe, in Searcy County, in operation. It is producing a high-grade jack concentrate and will ship a car in May.

▶ Reed Brothers of Flippin, in Marion County, who are doing development work on the Fred Morton land, on Music Creek, in the north part of the county, struck a new type zinc ore this week. It is a powdered carbonate and runs well up into the thirties in metallic content. It lies in a vein like clay. They have also cut into some good carbonate ore.

▶ James Rogers, of Harrison, who is operating on a lease on the Coon Hollow tract at Zinc, in Boone County, is making a thorough test of the ground. During the first World War a series of tunnels were driven into the mountain from the Coon Hollow side, from which a big production of free silicate of zinc was made. A good production of the same type of ore was also made on the other side of the mountain. Mr. Rogers has sampled all of the ore-bearing ground these tunnels were driven into, and it averages 13.3 percent metallic content. He is now driving a tunnel into the area back of these tunnels. He has also encountered new ore leads above the old tunnels by shooting through the old roofs. His equipment at this time consists of a compressor and drift drills. The tonnage of crude ore he has already proved up is ample to supply a mill for a long period. He expects to install a milling plant sometime this year.

▶ The Moark Mining Co., at Zinc, Ark., in Boone County, operating the Almy, Jackpot, Minnie Lee, and Red Mill, is now in production. It will ship a car of silicate of zinc concentrates in May. Operations are in charge of C. T. Rabineau. The company has completed a trestle from properties across the narrow valley, to its mill, over which it will move mill dirt to the plant. It has added a new compressor and drift drill to its equipment which it will use in driving a long test tunnel on the Jackpot. Work on this tunnel will be resumed immediately after excess water from heavy May rains can be disposed

ı. The Jackpot produced a large tonage of high-grade jack during the first World War.

MICHIGAN

Appraisal of Copper Mines Shows Drop

Houghton County registers decrease, while Keweenaw County has small increase—Non-Ferrous Metals Commission rules on C.&H. labor case

The aggregate valuation of mining properties in Houghton and Keweenaw counties as recommended to the State Tax Commission by Franklin G. Pardee, state appraiser of mines, is $519,471 lower than the final valuation for 1942. The total recommended valuation for the two counties is $6,116,179, compared with $6,635,650 a year ago. Figures for both years include refined copper on hand at the time of assessment.

The recommended value of properties in Houghton County this year is $4,611,-179, against $5,160,650 a year ago, a reduction of $549,471. The tentative value on the Calumet & Hecla reclamation plant is $450,000 under the value fixed by the tax commission last year, this property being reduced from $2,290.-000 to $1,840,000. This reflects the steady depletion of the conglomerate tailings from which copper is being reclaimed. The only other big reduction in Houghton County was for refined copper, which was valued at $616,179 this year, compared with $705,650 last year.

The only Houghton County property which is recommended by the appraiser for an increase in valuation is North Kearsarge, which is boosted from $50,-000 a year ago to $105,000 this year. North Kearsarge is now an active property, which accounts for the larger valuation.

In Keweenaw County, the total recommended valuation is $30,000 higher than a year ago, being raised from $1,475,000 to $1,505,000. Ahmeek & Allouez is recommended for a decrease of $280,000, and Douglass Copper and Seneca and Iroquois are recommended for increases of $200,000 and $100,000, respectively. More copper now is being mined from the two properties last named than a year ago.

The Non-Ferrous Metals Commission has issued an order in the case of the Calumet & Hecla Consolidated Copper Co. and Local 584, International Union of Mine, Mill and Smelter Workers, CIO, in which it is stated, in effect, that union membership by an employee is not compulsory. "The union agrees," the order says, "that neither it nor any of its officers or members will intimidate or coerce employees into membership in the union. If any dispute arises . . . the dispute shall be regarded as a grievance and submitted to the grievance machinery." The order also states that so far as wages are concerned, any change in the present scale must first be approved by James F. Byrnes, Economic Stabilization Director.

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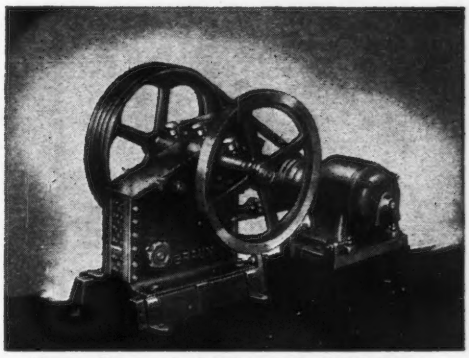

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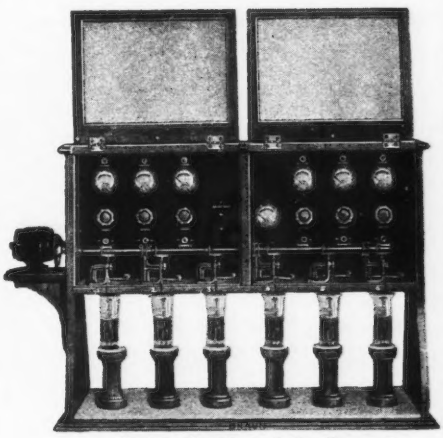

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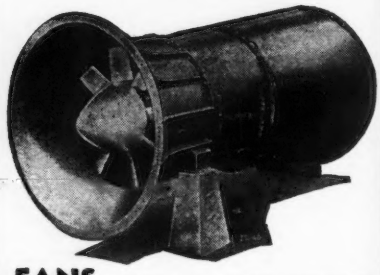

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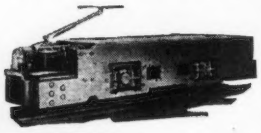
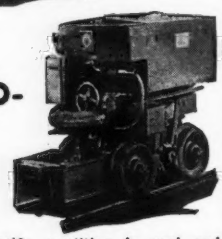


MINE LOCOMOTIVES



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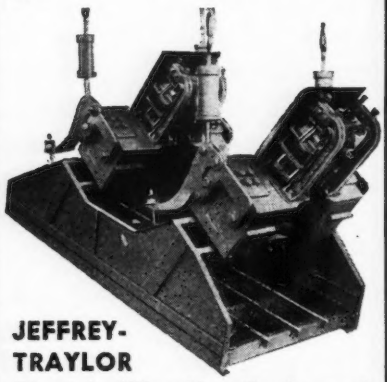

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Unloading a Great Lakes ore boat at a Lower Lake port

IRON COUNTRY

Shipping Season Opens Month Later Than 1942

Stripping begins at Embarrass mine—Margaret mine being dewatered—Plymouth mine installs skips

▶ On April 24, 1943, the first boats arrived at the Duluth and Superior docks and at the Lake Superior and Ishpeming docks for loading iron ore. This marked the opening of the 1943 navigation season, which is just one month later than the opening in 1942. This serious delay, caused by the severe ice conditions that prevailed everywhere from Buffalo, on Lake Erie, to Duluth and Superior, at the head of the Lakes, will create a tremendous challenge to the iron-mining industry, the railroads on the iron ranges as well as those servicing the Lower Lake ports, and the vessel operators. The quota for the Lake Superior district had been set by the WPB at 95,000,000 tons, but this was recently cut to 91,000,000 tons in view of the late start.

▶ Stripping at the new Embarrass mine, at Biwabik, commenced recently. Operations will be conducted by Winston-Morrison-Utah, contractors, for Pickands, Mather & Co. This is a joint name of Winston Brothers, of Minneapolis; Knudsen-Morrison Co., of Boise, Idaho; and the Utah Construction Co., of San Francisco. When operations are at full capacity there will be a fleet of 13-yd. and 25-yd. trucks servicing several large electric shovels. J. A. Terteling Co., of Boise, Idaho, is setting up its equipment for the digging of the diversion ditch to drain the waters of Wine Lake from the future pit area.

▶ The C. W. Moore Mining Co. has commenced dewatering the Margaret mine, at Buhl, Minn., and shipments are expected to start soon. A small washing plant will be installed later. This mine was formerly operated by Butler Bros., but has been inactive since 1934.

▶ After operating the Plymouth mine, on the Gogebic range, as an open pit since 1916, with steam locomotives, it was necessary for Pickands, Mather Co. due to excessive depths, to change the system this spring to a truck and inclined-shaft combination. Two 6-ton skips in balance operate on the south side of the pit at an angle of 27 deg with the horizontal for a distance of 650 ft., dumping into railroad cars at surface. The skips are lifted by an electric hoist transferred from the Sunday Lake mine and driven by a 400-hp motor. At the bottom floor the skip pockets are filled by five 6-ton International trucks operating on an average distance haul of 4,000 ft. from the shovels to the pockets. Production started on May 4 with one shift, but a second shift will be added in the near future, as 600,000 tons will be shipped before Nov. 15. Three of the old steam locomotives have been sold, but one locomotive will be retained for the summer to salvage the steel rail and other equipment to be removed from the pit. Up to Jan. 1, 1943, this property had shipped 13,010,325 tons of ore, and an additional 24,000,000 tons of rock, lean ore, and stripping material has been removed from the pit. Everett Joppa is superintendent of the property.

▶ The standby emergency plan of two new ore docks at Escanaba is now near completion, and work will stop June 1. This plan covered the driving of piling for two docks and building the timber superstructure for pockets for only one dock. This is as far as the War Production Board will go at present, because of scarcity of labor and materials not only to complete the structures but to provide new railroad bridges necessary to place the docks in active service. Considering the present status of the war, it is doubtful if the new docks will ever be needed.

▶ To encourage planting of victory gardens and keeping premises in the best condition, the Cleveland-Cliffs Iron Co. is offering over $600 in prizes for the season of 1943 in Ishpeming, Negaunee, North Lake, Gwinn, Austin, Princeton and Iron River. For best-kept premises, 15 first prizes of $10 each are offered, with second and third prizes of $5 and $3. For best vegetable gardens, a second set of awards the same as for best kept premises is offered.

CANADA

Trail Employees Reject International Union

Manitoba tin investigation unpromising—New orebody at Steep Rock Lake—Report on Hudson Bay M & S Co.

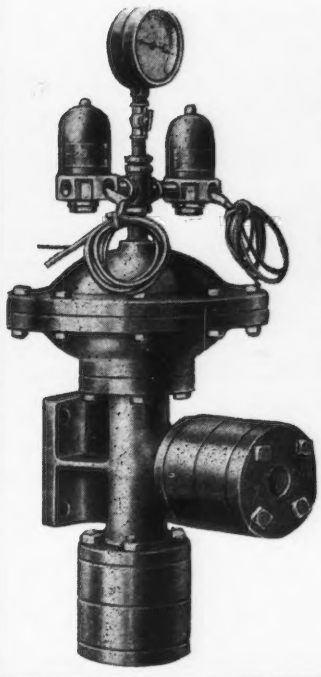
▶Strategic metals, base metals, and petroleum will receive chief attention this year in the geological and topographical field work of the Mines and Geology Branch, Department of Mines and Resources, Ottawa. Areas along the Alaska Highway are included in the geological program, the main purpose of this work, in which three parties will be engaged, being to acquire information on the mineral possibilities of the areas.

Thirty-one geological and nine topographical parties are being assigned to field work. The former will map and investigate areas in every mining province in the Dominion and in Yukon and the Northwest Territories.

▶Agitation aroused by the proposed treaty between Canada and the United States for the prevention of fraud in the sale or purchase of securities may result in amending the criminal code so as to standardize and strengthen authority held by the several provincial security commissions. The treaty is being framed at the instigation of the Securities and Exchange Commission and is being strongly opposed by representatives of stock exchanges of the Dominion, the Toronto Board of Trade, the Ontario Unlisted Dealers' Association, and the Prospectors and Developers Association. Under the terms of the proposed treaty, mining promoters and others dealing in fraudulent securities would be classed with those guilty of major criminal offenses who are subject to extradition.

▶A sharp criticism of the labor policy of the federal government was voiced at the annual meeting of the Mining Corporation of Canada by its president, J. H. C. Waite. It was charged that political expediency accounted for the failure of National Selective Service to assist base-metal mines. At these mines the scale of operations had been drastically curtailed along with the less-favored gold producers. Selective Service is held responsible for forcing men out of the mines "to grow wheat we don't want, or to merely subsistence farms or worse." Labor shortage had led to a 33 percent reduction in tonnage milled by the subsidiary, Base Metals Mining Corp., at Field, B. C., and the mill rate of Normetal Mining Corp. in northwestern Quebec had been reduced from 750 to 460 tons a day. It was expected that Jerome Gold Mines would be forced to shut down in July.

▶Canada's aluminum industry is approaching the proportions of the gold-mining industry at its peak of two years ago. Operations are on a scale that makes possible the production of 500,000 tons of metal a year, and the expansion program that is still in progress will raise the value of annual output to about $200,000,000. Successful applica-



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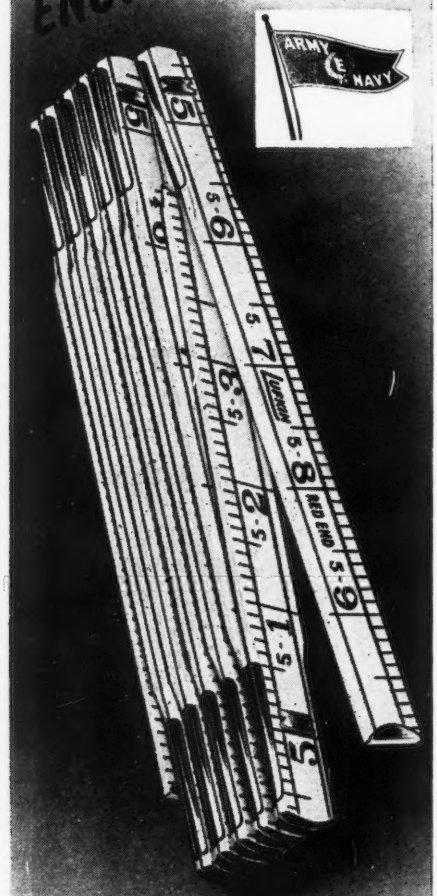

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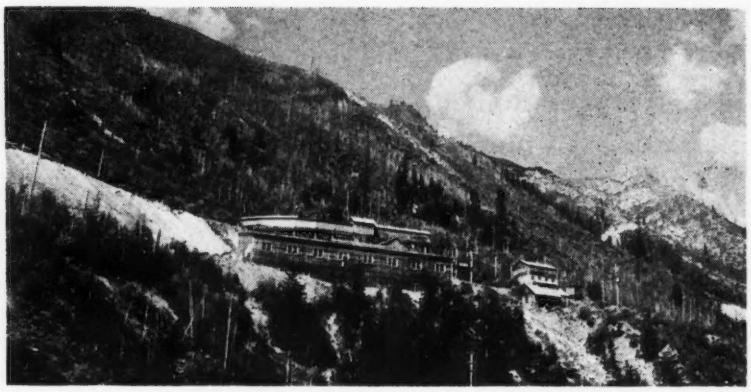

Mill of Gold Belt Mining Co., Ltd., on south slope of Reno Mountain, near Sheep Creek, British Columbia

▶ CANADA

tion of the Canadian developed Pidgeon process for the recovery of magnesium metal has likewise given promise of developing into an industry of considerable proportions. This year's output of magnesium from Canada's initial plant is expected, according to report, to be around 4,500 tons of metal, valued at almost $2,000,000.

ONTARIO

▶ Shareholders of Sylvanite Gold Mines have been notified that difficulties in obtaining both labor and supplies have forced a reduction in mill rate from 600 to 400 tons a day, with further cuts in prospect. Average daily output in 1942 was 480 tons. It has been necessary to curtail much of the development program that was carried on successfully last year. Delnite Mines, a subsidiary of Sylvanite in the Porcupine camp, has so far avoided reducing the daily tonnage treated and is holding close to the 400-ton capacity. A second subsidiary, Tyranite Mines, was forced to shut down last year on account of labor shortage.

▶ Encouraging results have been reported on the preliminary exploration of an iron property held jointly by the Frobisher Exploration Co. and Sherritt-Gordon Mines. The property is between the east and west arms of Steep Rock Lake and the ore deposit has some similarity to the main Steep Rock bodies, which are being prepared for production. The only surface evidence of iron ore is in the float found over an area south of Straw Hat Lake. Six of the ten drill holes that have probed below the lake were successful in locating ore, which is assumed to be distributed in two, and possibly more, zones. The iron content varies between 41.85 and 58.34 percent, with upwards of 5 percent manganese.

▶ Construction of the 125-mile transmission line to serve the Steep Rock Iron Mine development has commenced. The line will run from Port Arthur westward to the mine location, and permit of power being delivered from the power plants of the Ontario Hydro-electric system at Cameron Falls and Alexander Landing on the Nipigon River.

MANITOBA

▶ Recent exploratory work on several low-grade tin deposits has failed to indicate possibilities for successful development in the present emergency, according to a report by Dr. J. D. Bateman, of the Canada Geological Survey. After an investigation of all the known occurrences of the tin-bearing pegmatite and albitite dikes and the sulphide deposits in shear zones, it is recommended that prospecting efforts should be directed to the shear-zone areas and albitite dikes. At least 18 pegmatite dikes have been tested in the area between the Bird and Winnipeg rivers and in all of them the values were found to be too low for any known recovery method. In the vicinity of Shatford, Rush, Redsucker, and Beresford lakes, diamond drilling and surface work have been in progress intermittently since 1939, but several showings remain to be tested adequately for an estimate of commercial possibilities. God's Lake Gold Mines and associated companies control several groups of claims at Rush Lake, where the most promising occurrence of cassiterite in the province has been explored.

▶ Hudson Bay Mining & Smelting Co. is the second largest zinc producer, the third largest copper producer and fourth largest gold producer of all Canadian mine operators, with a mill rate maintained at 6,150 tons daily. In an effort to replace the dwindling labor supply, a total of 160 women are being employed on surface work. According to the last published statement on ore reserves, at the end of 1938 the average grade was shown to be $3.62 in gold (at the present price in Canadian funds), 1.44 oz. silver per ton, and 4.20 percent zinc and 2.23 percent copper, on 27,534,000 tons. Extensive development work since 1938 is believed to have added considerably to block-out tonnage and to have resulted in some improvement in grade. Metal sales continue to be under contract at the same prices that were in effect in September, 1939. The higher mill rate and more efficient

recoveries have made it possible to cut working costs to about $3.80 a ton. Satisfactory results are reported from drill holes put out from the 3,000-ft. level, but development work has not reached below the 2,750-ft. horizon. Construction of a plant to treat zinc residues is being considered, following the encouraging results of a long program of experimental work. Hudson Bay's recently acquired Mandy property, which adjoins the main Flin Flon holdings on the south, has been equipped with a 200-ton mill that has been giving a satisfactory performance. Zinc-copper concentrates are being shipped to smelters in the United States. It is reported that preliminary development work has extended the ore blocked out during former operations in the first World War. The property has been inactive since operations were started at Flin Flon. The major deposits of chromite that were discovered a year ago in southern Manitoba are held by Hudson Bay under option and exploratory work is still in progress.

BRITISH COLUMBIA

▶ Employees of The Consolidated Mining & Smelting Co. of Canada, Ltd., at the Trail smelter and Warfield chemical plants, have voted 1,977 to 1,888 to retain the Workmen's Cooperative Committee as the official bargaining agency of the men, as opposed to the International Union of Mine, Mill and Smelter Workers. The International union has endeavored for years to gain a foothold at Trail, and since the adoption of legislation in this province compelling the recognition of trade unions as bargaining agencies if approved by a majority of employees, has redoubled its efforts. The strength of the union vote is largely accounted for by the absence of 1,700 regular employees on military service, together with the company's rigid policy of advising all replacements of the temporary nature of their positions. Since the taking of the poll, the Hon. George S. Pearson, B. C. Minister of Labor, has ruled that the Trail and Warfield plants are covered by Dominion orders-in-council under the War Measures Act and that the British Columbia Industrial and Conciliation Act does not apply. In a vote conducted by the union, Kimberley employees of Consolidated are reported to have voted 750 to 540 to authorize the International union to act as their official bargaining agency. So far no ruling has been forthcoming as to the application of federal orders-in-council in this case. Meanwhile, application has been made to the B. C. Department of Labor for recognition of the union. Kimberley employees work in the Sullivan mine and mill, source of the silver-lead-zinc production of the company.

▶ After including Yukon Territory in its service for the past 30 years, the B. C. Chamber of Mines has decided to include it also in its name. The future title will be "British Columbia and Yukon Chamber of Mines."

▶ The Vancouver branch of the Canadian Institute of Mining and Metallurgy has reelected W. G. Norrie-Loewenthal chairman for the ensuing year. Other offi-

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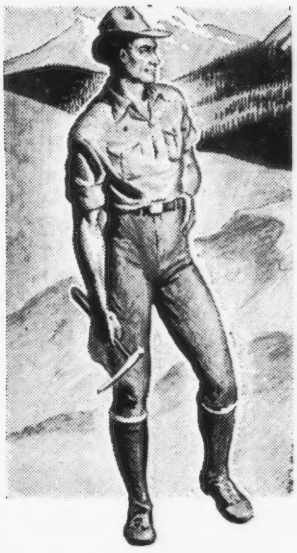

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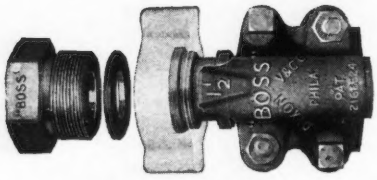

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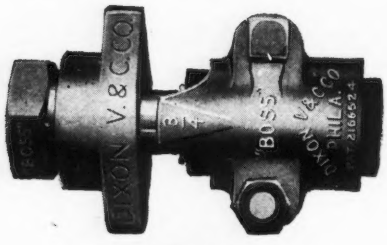

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▶CANADA

cers elected include: first vice chairman, Colin J. Campbell; second vice chairman, Dr. H. C. Gunning; and secretary-treasurer, Fred H. Stephens. Col. Frank M. Steel, federal explosives inspector, addressed the annual meeting on his experiences as liaison officer between the Canadian Government and the U. S. Army Engineers in the Northwest Territories. The Hon. E. C. Carson, Minister of Mines, addressed the May meeting on recent British Columbia mining legislation.

▶ During the last quarter of 1942 Premier Border Gold Mining Co., Ltd., obtained a credit of $1,133 as profit on ore from its Northern Light claim, milled by Silbak Premier. Advances and expenditures of approximately $40,000 must be repaid Silbak before Premier Border begins to share in the profits.

▶ Granby Consolidated Mining, Smelting & Power Co., Ltd., Similkameen mining division, reports net operating profit for the first quarter of 1943 at $52,800, after all operating charges and provision of $31,657 for taxes and $71,801 for depletion and depreciation. The regular quarterly dividend of 15c. per share will be paid June 1 to shareholders of record May 14, subject to the approval of the Foreign Exchange Control Board. Employees at both the Copper Mountain mine and the Allenby concentrator have been organized into locals of the International Union of Mine, Mill and Smelter Workers, and are now asking for recognition of that body as the official bargaining agency. Some time ago the company recognized the Princeton local of the United Mine Workers of America as the bargaining agency of its employees in the Granby colliery.

▶ During the fiscal year ended Dec. 31, 1942, Hedley Mascot Gold Mines, Ltd., Osoyoos mining division, produced gold bullion valued at $766,985 from 66,099 tons, averaging 0.347 oz. gold per ton. After all operating costs and provision of $80,357 for depreciation and amortization of haulage tunnels, and $59,776 for taxes, net profit was $116,082. Dividend disbursements, aggregating 8c. per share, involved $181,130. Development work comprised 520 ft. of drifting, 809 ft. of raising, 11,813 ft. of underground diamond drilling, and 997 ft. of surface diamond drilling, at a total cost of $38,080, equal to 57c. per ton of ore milled. Dr. Victor Dolmage, consulting geologist, in his report to shareholders states that despite the restricted exploration due to the labor shortage and the maintenance of production at close to normal, new ore found during the year almost equaled the amount mined. At the year-end proved ore reserves were estimated at 190,000 tons, a quantity sufficient for more than three years' operation. A dividend of 2c. per share was paid on May 15 to shareholders of record April 20.

▶ Highland-Bell, Ltd., Greenwood district, British Columbia's only producer of silver exclusively, received $239,932 during 1942 for shipments of ore to the

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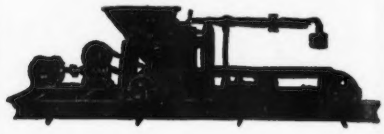

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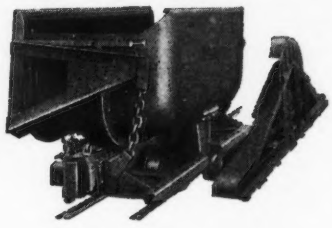

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Trail smelter. Although this represents a reduction of 20.17 per cent from 1941 receipts, net operating profit was $128,159, or 9.7c. per share, as compared with $126,076, or 9.6c. per share, in the previous year. Owing to the approaching depletion of currently producing orebodies, shareholders have been warned that future development may necessitate the driving of a 2,500-ft. crosscut to explore the lower levels of the Highland Lass vein.

▶ Shareholders of Beaver Silver Mines, Ltd., have approved the sale of the Beaver Silver claim on Wallace Mountain, Greenwood district, to Highland-Bell, Ltd., for a reported price of $48,000. The Beaver Silver company, which was incorporated in 1926 and is closely related to the Highland-Bell company, will be terminated and shareholders will receive a liquidating dividend of approximately 3c. per share.

▶ Following a suspension of milling in an effort to advance mine development to a point where continuous operations could be carried on with the limited crew available, Gold Belt Mining Co., Ltd., reports production valued at $47,089, from 3,187 tons, averaging $14.78 per ton in April.

▶ Sheep Creek Gold Mines, Ltd., largest gold producer in the Nelson area, suspended milling operations during the third week of April to effect necessary repairs to machinery and equipment and to replenish the diminishing supply of broken-ore reserves. The apparent impossibility of obtaining and retaining a capable operating crew has rendered such action necessary. The mill is expected to reopen this week. The company's wholly owned subsidiary, Zincton Mines, Ltd., in the Slocan division, is currently producing and shipping 1,000 tons of zinc concentrate monthly. In this connection, A. E. Jukes, vice president of both companies, has advised *Engineering and Mining Journal* that the monthly output could be doubled with the addition of 30 experienced miners. Mr. Jukes also advises that the recent contract for zinc production negotiated at Washington and Ottawa is more favorable to the company than any preceding contracts.

▶ Base Metals Mining Corp., Ltd., Golden mining division, subsidiary of the Mining Corp. of Canada, Ltd., produced lead and zinc concentrates to a value of $532,401 in the fiscal year ended Dec. 31, 1942. After mining, milling, and administrative costs of $364,642, and provision of $77,714 for deferred development, $4,101 for depreciation, $6,745 for mineral tax, and $25,503 for income and excess profits taxes, net profit was $53,696. At the end of the year positive and probable ore reserves were estimated to be sufficient for ten months' operation at the present rate.

YUKON TERRITORY

▶ Development of a placer-scheelite property on Dublin Gulch by Messrs. Swanson, Seaholm, and Lund, is being assisted by both the Dominion government and the Territorial administration.

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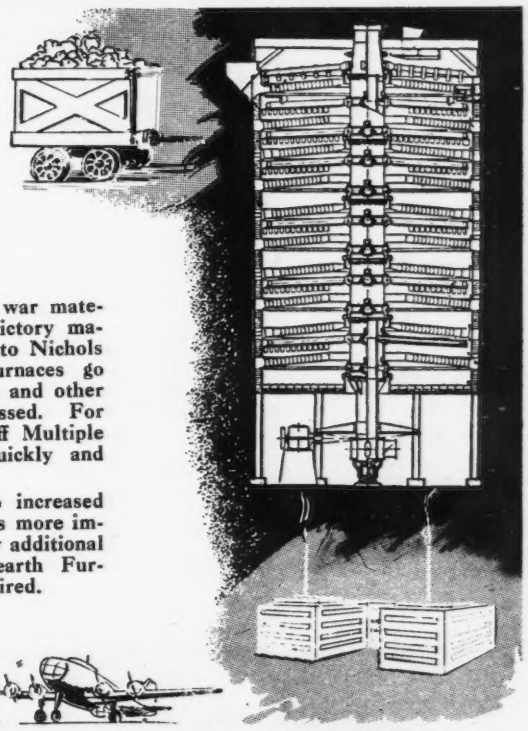

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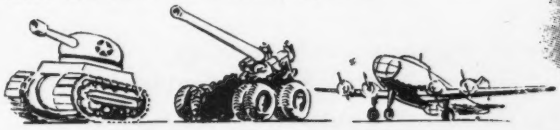

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GENERAL ELECTRIC

MEXICO

Important Antimony Discovery Announced

Government will not raise peso—Cooperative in Concepcion del Oro disbands—Several properties have labor trouble

▶ Late spring found Mexican mining considerably improved, with an upswing in production and exports, the highest in many years, the government said, though it released no specific figures on this activity. Mexican miners, generally, are applying themselves to work that means a full stint every shift. But some small companies, and even American Smelting, continue to have labor troubles. El Beneficio treatment plant of American Smelting's Hidalgo del Parral unit, Chihuahua, suffered a one-hour sit-down strike as a protest against the company's alleged unjustified dismissal of several workmen. The men were induced to resume work by the Chihuahua labor inspector and the labor ministry is investigating the case.

▶ Mines at Cubitos, near Pachuca, Hidalgo, are assured abundant and sustained electric power with the nipping of a strike. The power company granted all its help's demands, including a 10 percent pay hike.

▶ The industry is relieved about rumors current in financial circles of Mexico City that the government is soon to force the peso up to the 3.60 per dollar level that prevailed up to the expropriation of the major foreign oil companies March 18, 1938, with the statement by Finance Minister Suarez that there is no substance to the reports and that the current 4.85 rate will be continued. "The government has no desire to provoke upsets in national economy, particularly exporting," the official declared. Mining men had been worried by the rumors because fewer pesos for dollars would work a hardship on them as most of their income is derived from exporting.

▶ The Santa Barbara unit, Chihuahua, of the Cia. Minera Asarco, the Metalurgica Mexicana, and the Mexican Lead Co. have provided 107,000 pesos ($22,500) to enable Section 11 of the national miners union, which includes their employees, to found and conduct a consumers' cooperative society that is intended to provide these workers with less expensive food and other prime necessity articles. The cooperative, which will be the largest of the kind in Mexico, is to be administered by the Labor Ministry.

▶ That mining labor cooperativism, which was introduced by the Cardenas government eight years ago, is not the golden key to prosperity for the workers is again demonstrated by the forcing out of business of the Cooperativa Minera "15 de Octubre," that had worked some mines in the Concepcion del Oro zone, Zacatecas. This society decided to quit when its miners and millmen served an ultimatum that they must find jobs elsewhere unless they received

their weekly pay in full and on time. For some time, the cooperative's members had been receiving only half pay. The cooperative blamed its economic plight on Mazapil Copper, which also works in the Concepcion del Oro region and which had embargoed some of the cooperative's concentrates in connection with a debt. Mazapil denied that its embargo had forced the cooperative to suspend. It declared the cooperative was utterly destitute and that was the true reason for its failure.

▶Mining circles consider it likely that the Ministry of National Defense will exempt those mining company employees, such as watchmen and money handlers who are exposed to danger from the lawless, from its recent general orders restricting the bearing of firearms to members of the armed services, police, and other military and civilian guardians. This matter was brought up by the Cia. Minera Santa Maria del Oro, S. A., Magistral, Durango, when it asked that its watchmen and payroll men be allowed to bear firearms. The company said that its money handlers are exposed to particular risk while moving money between Magistral and the company's other workings at Rosario.

▶El Potosi was authorized to dismiss 21 workers of its treatment plant at Santa Eulalia, Chihuahua, with the payment to them of indemnifications totaling 65,718.64 pesos.

▶Ing. Aguiles Serdan, son of a hero of the Mexican Revolution, is organizing a company in Mexico City to undertake large-scale exploitation of an important antimony deposit he recently discovered on land he holds under federal concession in the Mixtepec region, Oaxaca. Ministry of National Economy geologists who examined the deposit reported that the antimony is of high grade and that exploiting it would pay. Ing. Serdan graduated as a mining engineer in the United States in 1932 and has been practicing in Mexico for five years.

▶Labor difficulties have become so acute for Cia. Minera El Tigre, S. A., operating in Nayarit, that its manager, Antonio C. Toledo, has asked for troops to protect the property. In making this demand, he declared that the trouble is due largerly to prospectors raiding the properties. The miners declare there is no reason for having soldiers sent. They assert the whole trouble arises from the company's refusal to grant them a pay hike. They threaten to strike unless their demand is met. The Labor Ministry is seeking to settle the dispute, which has already caused a series of short sit-down strikes.

▶Hidalgo, one of Mexico's oldest mining states, is advancing that industry with the working of many tracts that had long been idle and also of small orebodies. Most of this work is being done in the Pachuca, Zimapan, and Zacualtipan zones by various companies, including U. S. Smelting & Exploration; Cia Minera la Reina y Anexas, S. A.; Cia. Exploradora de Hidalgo, S. A.; Cia. Metalurgica de Antotonilco, S. A.; El Chico, S. A.; Neg. Minera del Espiritu Santo y San Zenon; Cia Minera La Union, S. A.; and Cia. de Minas Santa

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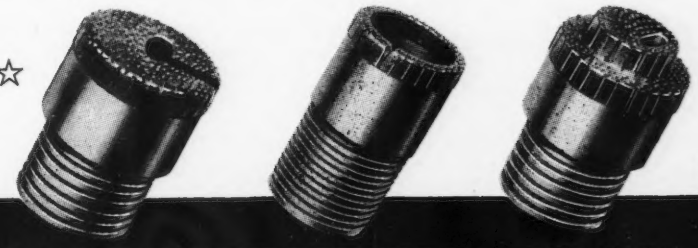

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▶MEXICO

Ana y Anexas, S. A.

▶ Oil shortage is afflicting several Sonora mining companies, particularly those in the Santa Ana region, where it is hampering all mining operations. The companies have been promised early relief by Petroleos Mexicanos, the official oil company.

▶ Altos Hornos de Mexico, S. A., which is establishing an important iron and steel works at Monclova, Coahuila, headed by Gen. Abelardo L. Rodriguez, ex-President of Mexico, and backed by American Rolling Mills and the U. S. Import & Export Bank, announces that it invested 10,706,453.94 pesos in machinery and equipment last year and that it will make a general investment of $3,350,000 (U. S.) this year and $600,000 in 1944. This company has just smoothed out labor trouble resulting from the national miners union demand that it have control of all workers, even those in departments that are not actually concerned with mining, such as construction workmen. The union agreed to limit its labor control to those company employees who are directly engaged in mining and allied activities.

▶ The Ministry of the Interior has started making personal identifications of mining and allied industries workers as a wartime security measure. Some mining companies that sought to make these identifications on their own encountered great opposition from their workers.

▶ The management of Compañia Minera del Cubo, S. A., states that *E. & M. J.* was in error in reporting a cave-in at the Villapando mine in the April issue, p. 119. The facts were that a loaded skip fell from the fourth level to the eleventh level in the inclined North shaft. In its fall the skip did considerable damage to the shaft below the seventh level. The accident was due to a broken cable, probably after being kinked. The interference with production until the shaft was repaired made it necessary to lay off 80 men for approximately one month, after which they went back to work. These men did not appeal to the Labor Ministry, as reported. Because the property is a gold-silver producer, the management had been unable to obtain a spare cable since July, 1942, because of WPB refusal to grant adequate preference ratings. After the accident an emergency rating was secured through the American Embassy.

Republic Steel Leases North Carolina Mine

REPUBLIC STEEL CORP. has taken a lease on the Cranberry iron mines, in Avery County, N. C., and is negotiating with the War Production Board in regard to the development of the property. The mines are the property of Tennolina Corp. They were first opened in 1883 and operated continuously until 1929. Peak production was obtained during the first World War. When operations ceased, equipment was junked.

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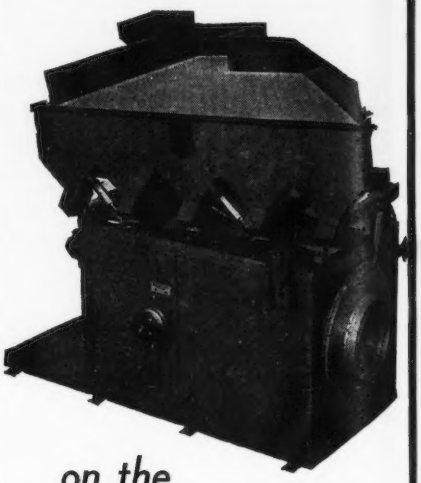

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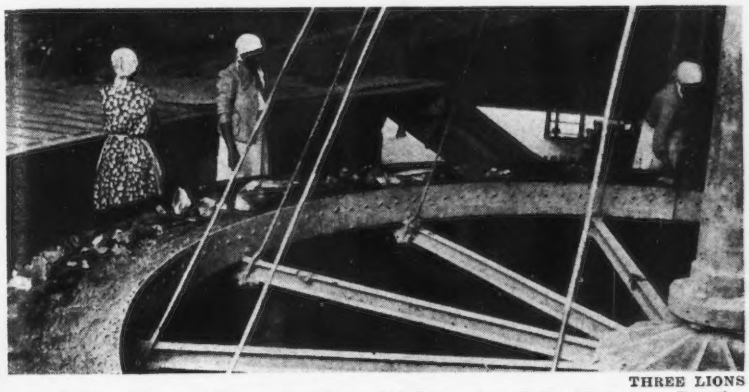

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Revolving picking table at San Juan del Rey mine, Bello Horizonte, Brazil

PERU

New Mill for Gold Tungsten Property

Santa Ines mine has new plant—Transportation problem is getting serious—Argentine seeks to purchase Peruvian zinc

▶Sociedad Minera Suizo-Peruana Julcani, a gold company with properties in the Department of Huancavelica, is now in the process of erecting a new plant for the concentration of a new type of ore, quite abundant within its claims. This ore contains gold and tungsten, and has been for some time the subject of intense research. Adequate treatment has apparently been found.

▶The Colquipocro 150-ton flotation plant, belonging to the Cajabamba Mining & Milling Co., has been acquired by the Castrovirreyna Metal Mines Co. and is being erected at the Santa Ines mine, in the Department of Huancavelica, near Castrovirreyna. Santa Ines was famous in Spanish colonial times, and also at the beginning of this century, as a silver producer, and is said to contain large tonnages of lead and zinc ores. Besides there are some large dumps left by the former owners, carrying high values in silver. The plant is being installed near the mine itself, and the power plant, a hydroelectric turbine, is being placed near the town of Santa Ines, 10 miles away. Production is expected to start in September.

▶Compañía Carbonera Huayday S. A., an entirely new company, established about six months ago, with coal properties in the Huayday region, is now ready to start operations. Huayday is inland from Trujillo, about 450 miles north of Lima. The coal is good anthracite, and reserves are said to be large. This type of coal is not used much in Peru, but a contract with a firm in Argentina has created a steady market for this product.

▶The transport situation is becoming a serious problem, mainly because Peru has relied almost entirely on roads, there being few railroads in the country. Mining companies, with the exception of those in the central region which are connected by a good railroad, are finding it difficult to get tires, spare parts, and vehicles. A tire factory now being completed in Lima will be of great help This factory will start operations in July, has a capacity of 50,000 tires a year, and will use Peruvian rubber and cotton exclusively.

▶There has been a great demand lately, from Argentina, for Peruvian electrolytic lead and zinc, although up to the present no shipments have been made. Peru has been exporting this type of lead and zinc to Brazil for some time.

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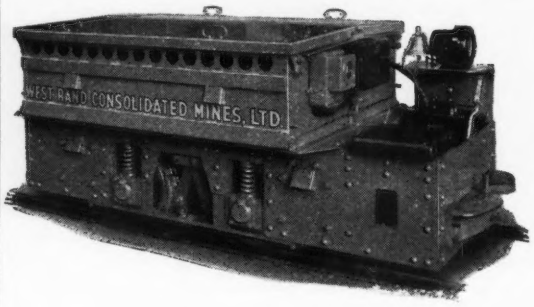

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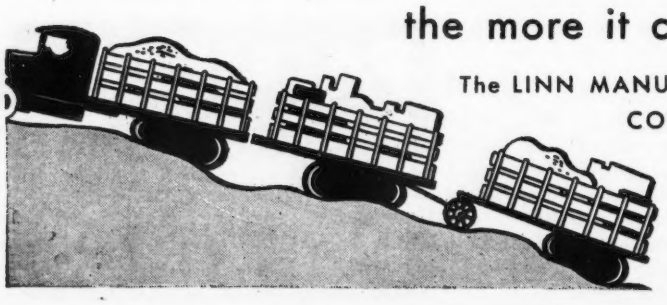

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AFRICA

Gold Producers Worried Over Burdensome Taxes

Blyvoor continues strong showing—Government plans to study tax relief—Consolidated Diamond Mines doubles profit

▶ The problem of the future value of gold, which, as might be expected in these topsy-turvy times, has been bothering Witwatersrand mining interests, now causes much less concern. This is largely the result of both the American and British plans for the stabilization of exchange after the war, adhering to gold as the value standard. Sir Ernest Oppenheimer, whose judgment is always highly regarded, referred to the matter at the meeting of Anglo American Corporation of South Africa and pointed out that history shows that gold has stood the tests of all past upheavals and so become the token of wealth of all nations. He sees the "gold mines special contribution" as merely a war-time emergency tax, as its name indicates, and believes that taxation will be so adjusted as to facilitate the raising of the immense sums which will be required for the exploitation of new mines on the western Witwatersrand and in the Orange Free State.

▶ Blyvooruitzicht, the new wonder mine of the West Rand, developing its 14-in. Carbon Leader of phenomenal richness, set up a new high record of profit in April. From the milling of 10,000 tons of ore, mostly from development openings, it made a profit of £10,925, despite an increase in operating costs of nearly 5d. per ton. The cause is higher-grade ore. During the last quarter the 5,205 ft. of new openings sampled averaged 68½ dwt. per ton over 13.4 in. width. The proportion of payable reef opened continued to be 100 percent, which seems to be without precedent in the Witwatersrand. Its shaft is about a mile deep.

It is stated that the considerable decrease in Crown Mines's ore output last year was due to native labor shortage, which was particularly severe during the latter part of the year. This decrease, in this single mine, more than accounted for the total reduction in the whole of the Witwatersrand district, being 354,000, against 275,750, tons. Crown reduced its development footage severely, "to conserve steel and other stores," and its ore reserve was down by 2,317,600 tons, at 22,033,100 tons, at the end of the year. The value of its reserves was up 0.1 dwt. at 5 dwt. per ton over an unchanged width of 44.9 in.

▶ Western Reefs established a new high record of working profit in April, £75,596, against £74,090 in March. Daggafontein, East Daggafontein, South African Land, and City Deep made slightly larger working profits than in March also. As a result of curtailed development work, ore reserves generally decreased somewhat last year, but another result appears to have been the

practical maintenance of the preceding year's average production costs. For instance, East Rand Proprietary's average was 1s. 4d. lower, at 22s. 6d. per ton milled, notwithstanding a decrease of 91,000 tons in output, to 2,592,000 tons, due to shortage of labor. The pictures presented by the reports of several other large mines are roughly similar, West Rand Consolidated showing a working profit of £1,904,746 last year, against £1,939,769 in 1941, tonnage of ore milled being down from 2,840,000 to 2,777,000, and new development from 105,710 ft. to 52,613 ft. Operating cost was about 3d. per ton lower. Though ore reserves were reduced by 833,000 tons, 9,767,000 tons remain, of a value of 4.3 dwt. over widths averaging 46 in. It will be seen that this is the result of the policy generally decided upon about two years ago as a war measure. The difficulty of obtaining supplies and the shortage of labor have proved its wisdom. Nevertheless, it brings to the front the question of wasting assets, in view of the necessarily high rate of war taxation.

▶It is now the announced intention of the British government to provide some excess-profits taxation relief to those producers, such as of minerals and oil, that have made capital expenditures, or resorted to measures which will increase their cost of production after the war, in order to contribute more largely to the war effort. The Chancellor of the Exchequer disclosed this fact in his budget statement. Consideration of this will, of course, cause every feature of the relationship of the companies to the war effort to be examined. The vitally important items will be found to be wasting assets, depreciation, return of capital invested with interest, and the privilege of making sufficient profit to compensate for risk and to tide over possibly recurring bad times, and to provide new equipment in keeping with the progress of mechanical improvement. These matters are as vital in wartime as in peacetime.

▶The Northern Rhodesia copper companies are commonly considered here to have made the greatest sacrifices of any to support the war effort. They have sold their production to the government for much less than the current market prices, have made heavy expenditures to expand output, have paid the maximum of high taxes and war contributions, and have made large loans to the government free of interest. In consequence it is expected that they will be entitled to relief of a substantial character.

▶Ashanti Goldfields treated 18,300 tons less ore last year than the year before, the total of 210,000 tons yielding 235,527 oz. of gold. Ore reserves decreased 40,505 tons, to 2,036,011 tons averaging 21.9 dwt. Development was largely reduced to conserve supplies, the larger portion being on the No. 32 level, where two crosscuts revealed a width of 17.5 ft. and values of 56.7 dwt. Profit was £1,156,537, down by £170,159. Dividends were unchanged at 80 percent.

▶Bibiani, Ltd., earned £230,256, against £370,545 in 1941, but paid 25 percent, the same, in dividends. Shortage of supplies caused output, development work, and operations generally to be curtailed. A large interest in Bibiani is owned by Ashanti, and the two are under practically the same management.

▶The profit of British South Africa Co. was up £102,825, at £807,914, in 1942. All of its several sources of income improved, except that it got smaller dividends on its holdings of Northern Rhodesia coppers. Profits after taxes and depreciation increased £60,000. This is the company formed by the great Cecil Rhodes. For the first 20 years of its existence it did not pay a single dividend, devoting all its income to the government and organization of the Rhodesias.

▶Consolidated Diamond Mines of South-West Africa's 1942 profit was almost doubled, being £1,286,707, or £635,022 more than in 1941, and £76,455 over its previous high record. This year's profit is up £360,067 after provision for taxation. This remarkable increase of prosperity is probably almost wholly due to the increased market demand for industrial diamonds.

▶A. Chester Beatty has joined the directorate of Central Mining & Investment Corp., which is the largest of the "Kaffir" (Witwatersrand gold mining) financing companies. Central Mining is believed to have interested itself largely in Rhodesian coppers, Consolidated African Selection Trust, Selection Trust, Ltd., and other Beatty enterprises. It has an enviable record of successes.

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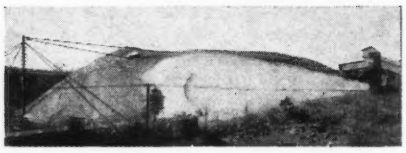
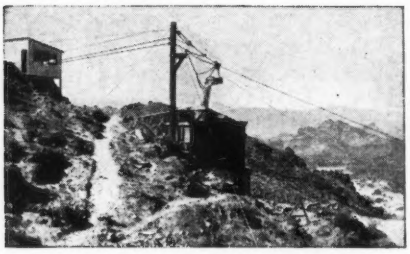


Small Sauerman Scraper (¾ cu. yd. capacity) stores and reclaims 50,000 tons of crushed rock per year.



A 20 h.p. Sauerman Slackline Cableway operating a small bucket on a 1,000-ft. track cable, reclaims tailing from dump in valley to bin on hillside above mill.

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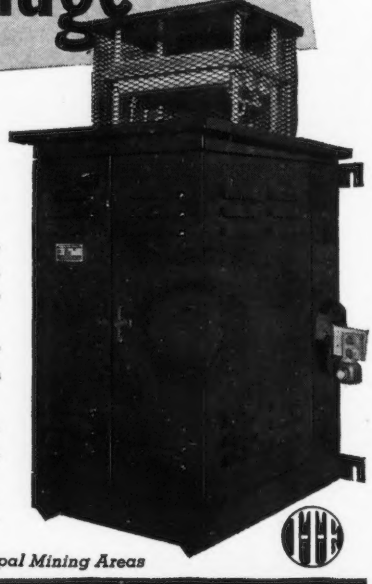

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AUSTRALIA

Mount Isa to Mine and Smelt Copper

Operations curtailed by manpower shortage—Milling capacity is increased—Lake View and Star report discussed

WESTERN AUSTRALIA

▶ The annual report of Lake View & Star Ltd., Kalgoorlie, for the year ended June 30, 1942, shows a record of remarkably good progress, despite the difficulties which faced the mining industry during the period. The net profit from mining operations was £Stg. 437,771, which compares with £Stg. 459,374 in the previous year. Although the decrease in profit was comparatively small, notwithstanding adverse conditions, it must not be expected that the rate can continue, for since the close of the year the labor position has become so bad that operations have been reduced to one shift per day. Of the net profit, £Stg.220,000 went to British taxation, £Stg.36,447 in depreciation, and £Stg.145,248 was distributed in dividends. The company is the largest operating in Western Australia and in the period covered in the report employed 1,200 men. Its property comprises a group of leases on the Golden Mile, originally worked by independent companies, including the mines of the old Lake View Consols, Golden Horseshoe, Ivanhoe, Chaffers, and Associated Gold Mines. The power plant is diesel-electric with a capacity of 2,000,000 units monthly and the treatment plant for crude ore has a throughput of 50,000 tons of ore per month. In addition, re-treatment plants are operating on accumulated tailings on two of the leases. In the first six months of the year development footage averaged 3,302 ft. per month, but it has been since reduced to a third of this figure. The total for the year amounted to 26,485 ft., or 11,000 ft. less than in the preceding year. The results of this work were satisfactory. Ore reserves in the company's leases are estimated at 4,200,200 tons, an increase of 69,500 tons and a decrease in grade of 0.12 dwt. gold per ton, the average value being 5.05 dwt. per ton. Reserves comprise positive ore, 2,931,400 tons; broken ore, 898,500 tons; probable ore, 370,300 tons. Crude ore treated for the year amounted to 596,955 tons of an average grade of 4.97 dwt. per ton, and the recovery was 90.5 percent. In addition, the re-treatment plant put through 840,909 tons of residues having an average value of 0.83 dwt. per ton.

QUEENSLAND

▶ Mount Isa Mines, Ltd., in North Queensland, has reached the highest profit level yet achieved, according to the balance sheet for the financial year ended June 30, 1942, in which net profit amounted to £A90,114. Operations were curtailed owing to progressively acute

shortage of manpower, a position common to all base-metal mines, which forms a striking commentary on the administration of manpower in view of the urgency for increased production of all strategic minerals. The most important feature of the company's operations has been the exploration and development of the Black Star copper orebody and the preparations in the mine, mill, and smelter for the production of blister copper. Shortage of manpower resulted in ore extraction greatly exceeding development, the difference being 438,995 tons, miners having to be transferred from lead-zinc development to stope preparation in the copper lode. Reserves of silver-lead-zinc ore were estimated as follows:

	Tons	Assay Value Ag, Oz.	Pb, %	Zn, %
Carbonate ore	72,200			
Sulphide ore				
Black Star lode	7,197,150	6.0	8.14	8.6
Black Rock lode	72,900	8.8	12.15	4.8
Rio Grande lode	182,800	14.1	13.7	5.6
Racecourse lode	950,000	5.9	8.2	8.7
Sub-total	8,402,850	6.2	8.3	8.5
Grand total silver-lead-zinc ore reserves	8,475,050			

Of this total, 3,335,000 tons are classed as developed ore and 5,140,000 tons as prospective ore. Copper ore reserves were estimated at:

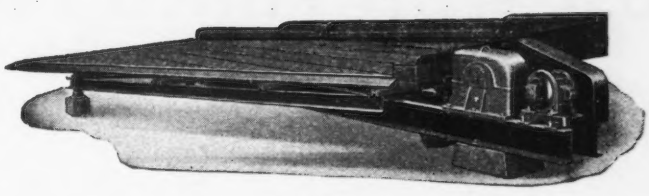
	Tons
Developed ore	1,055,070
Prospective ore	479,040
Total reserves	1,534,110
Assay value	3.03 percent

Total operating costs, including delivery of lead bullion into ship's hold at Townsville, a distance of 600 miles, but exclusive of all charges for copper development or the milling of copper development ore, for the production of zinc concentrates and for ocean freight, refining charges, etc., per dry ton, are shown below:

Mining and development	10s	11.02d.
Milling	5	3.79
Smelting	6	8.82
Administration and general expenses	2	5.34
Delivery of bullion, f.o.b. Townsville	2	2.50
Total	27	7.47

Underground diamond drilling totaled 12,319 ft., the greater part being in the Black Star copper orebody at the elevation of 7, 8, and 9 levels. As the orebody is irregular in character, relatively short intervals between holes was necessary to secure information for estimates of tonnage and grade and for stope design. Drilling in the Racecourse ore zone gave sufficient information for planning development of this orebody when labor is available. Development work, exclusive of stope preparation, amounted to 7,552 ft., compared with 7,432 ft. in the previous year. The work included 121 ft. of shaft sinking. As stated, conditions for mining were unsatisfactory, due to shortage of labor, which caused lower output and curtailment of stope preparation and development. Blast-hole drilling in connection with stope preparation and pillar reclamation continued throughout the year, the work being done on contract by a diamond drilling company.

312 SuperDuty Tables...



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Production is not stated but a reduced tonnage was milled in comparison with the record for the two previous years. Milling plant was increased by the installation of a 100-ft. diameter Dorr thickener, and by thickening the classifier overflow it was possible to maintain more uniform conditions in the flotation circuits. It was also possible to operate the classifiers with lower pulp density and thereby secure better classification and less overgrind in the ball mills. The improvement in the recoveries is due largely to the operation of the new thickener. Although metal recoveries were better than in the previous year, they were adversely affected by the intermittent operation of the milling units. Smelting practice was practically unchanged, the only alteration of importance being the provision of facilities for the effective screening of the product of the sintering machines. Screening of all sinter insured that the sinter charged to the blast furnaces was free from fine, partially roasted material, and thereby effected improved furnace expression and savings in coke consumption. Alterations and additions to the existing smelter plant for the purpose of producing blister copper were completed, the work including alterations to one lead blast furnace and the installation of converter equipment, as well as new flue systems. The copper plant will have a capacity of approximately 12,000 tons of blister copper per year.

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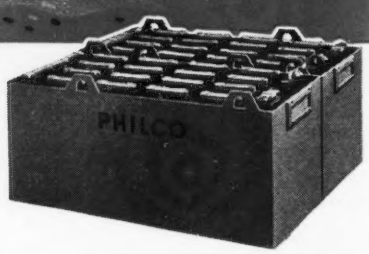

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Equipment News

Thickener Operation Recorder

AN ACCURATE continuous record of thickener operation is now available through use of the Dorr Torq Recorder, a recent development of The Dorr Co., New York, N. Y. Designed for use on Dorr "A" thickeners equipped with standard overload alarm, it is particularly applicable where appreciable fluctuations in the drive unit load are caused by variations in solids accumulation in the thickener.

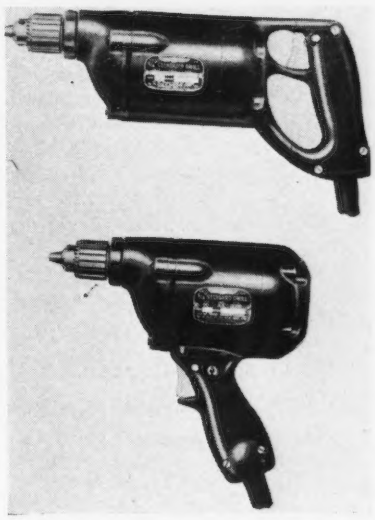
The Torq Recorder consists of two electrically connected control parts, a transmitting unit and a recording unit, the former built into the standard overload alarm on the drive head, and the latter located at any nearby point convenient for the operator. Because a complete 24-hr. record of thickener conditions is thus available, operation of these units will be improved. The operator can tell from the chart not only what has happened previously in the thickener but what will happen as well unless he makes the changes indicated by the trend of the load line recorded on the chart. Standard overload alarm and cut-out arrangements are not affected by use of the device, although these will seldom be needed if the operator pays reasonable attention to the information supplied him by the recorder.

Tail Rope Sheave

SCRAPER LOADING requires rugged tail-rope sheaves, and Sullivan Machinery Co., Michigan City, Ind., announces development of a ball-bearing sheave said to be well suited for this service. Side covers and sheave wheel are tough alloy steel, as are the forged hooks, eyebolts, and clevises; fast rope change is provided by the quick-opening snatch block construction; and greasing is required but once a year. Bulletin 76-D describes the new unit in detail.

Vibrating Conveyor

HIGH SPEED VIBRATION, set up by multiple pulsating driving magnets, is the actuating mechanism in a new pan conveyor recently announced by Syntron Co., Homer City, Pa. Shown in the accompanying illustration is a 35-ft. section of a 130-ft. conveyor recently built for handling extremely hot materials. Rate of flow is controlled by a rheostat which can be arranged for automatic operation if desired. Lack of abrasion of the unit by the material conveyed is said to be a feature of the design, and a wide variety of styles and capacities is available. Detailed information will be supplied by the manufacturer.



PLASTIC HOUSINGS are now provided for Black & Decker drills in the ¼-in. and the new ⅜-in. sizes shown above. The new drills are extremely light in weight and offer several operating advantages

INDUSTRIAL NOTES

Army-Navy "E" awards for excellence in the production of war materials have recently been awarded to the following plants: **Traylor Engineering & Mfg. Co.**, Allentown, Pa.; **Goodman Mfg. Co.**, Chicago, Ill.; **A. F. Holden Co.**, New Haven, Conn.; **Lufkin Rule Co.**, Saginaw, Mich.; and **B. F. Goodrich Co.**, Los Angeles, Calif. The Barberton, Ohio, plant of **Babcock & Wilcox Co.** was awarded the second renewal of its **Army-Navy "E."**

N. R. Knox was recently elected president of **Bucyrus-Erie Co.**, Milwaukee, Wis., in one of a series of changes designed to give increasing responsibility to younger men in the company. **W. W. Coleman** was re-elected chairman of the board, **W. L. Little** was elected vice president, **W. M. Bager** was appointed technical director, and **P. H. Birckhead** was made vice president in charge of sales.

Hardinge Company, Inc., York, Pa., announces that the name of its subsidiary company, **Steacy-Schmidt Mfg. Co.**, has been changed to **Hardinge Mfg. Co.**

Robert R. Zisette was recently appointed general sales manager of **SKF Industries, Inc.**, Philadelphia, Pa.

Ahlberg Bearing Co., Chicago, Ill., has elected **Fred O. Burkholder** as president to succeed the late C. J. Bender. **C. W. Pearsall,** general sales manager, was elected vice president.

Okonité Co., Passaic, N. J., announces the opening of a sales office at **904 Pere Marquette Bldg.**, New Orleans, La., in charge of **W. D. Stroud,** sales engineer.

Adam MacKenzie, vice president in charge of manufacturing, **Carboloy Company, Inc.,** was recently elected chairman of the Detroit section of the A.I.M.E.

BULLETINS

Placer Jigs. Various installation and operating suggestions are included in a set of notes on placer type jig operation prepared in bulletin form by Pan American Engineering Co., 820 Parker St., Berkeley, Calif. Numerous field-tested aids to better jig operation are presented.

Lathe Maintenance. A 28-page booklet on lathe maintenance, testing, and adjustment is now available without charge from South Bend Lathe Works, South Bend, Ind. Ask for Bulletin H4.

Telephone Cables. A new edition of the bulletin bearing this name has been issued by Western Electric Co., New York, N. Y. Full information on old and new types of lead-covered telephone cables is given, together with certain historical data.

Low-Temperature Brazing. Handy & Harman, New York, N. Y., will furnish to interested parties a general catalog on Sil-Fos and Easy-Flo low-temperature brazing alloys.

Fire Extinguishers. Complete data on use of all types of fire extinguishers are given in a chart furnished on request by American-LaFrance-Foamite Corp., Elmira, N. Y.

Hard Facing. Methods of hard-surfacing various machine or other equipment parts by application of a welded metal overlay are described in a new bulletin of Coast Metals, Inc., Canton, Ohio.

Blowers. Roots-Connersville Blower Corp., Connersville, Ind., has ready for distribution a bulletin, No. 120-B-12, describing the company's complete line of centrifugal blowers and exhausters.

Power Transmission. All types of V and flat belts and accessory equipment, together with gears, bearings, and pulleys, are described in a 20-page bulletin of Teuscher Pulley & Belting Co., St. Louis, Mo.

Construction Equipment. Chicago Pneumatic Tool Co., New York, N. Y., announces the preparation of a 63-page booklet describing the company's entire line of construction and mining machinery, including compressors, diesel engines, rock drills, diamond drills, and a wide variety of accessory equipment. Ask for Bulletin No. 600.

Tool Maintenance. Independent Pneumatic Tool Co., Chicago, Ill., has issued a booklet detailing how to get maximum service from portable electric tools.

Scraper Haulers. A new catalog describing its complete line of scraper haulers has just been issued by Sullivan Machinery Co., Michigan City, Ind.

Battery Replacement. Electric Storage Battery Co., Philadelphia, Pa., has prepared a catalog of Exide storage batteries which also contains complete replacement battery data and other engineering information.

Draw-point Spacing for Block Caving

(*Continued from page 75*)

the data used in plotting the curves of the graph on page 74 is demonstrated in the accompanying tabulations. The values have been worked out for three cases, in which the draw-point spacing has been taken at 20 ft., 30 ft., and 40 ft., respectively. The transfer development costs used have been taken from actual practice.

It is to be noted in these calculations that the block dimensions chosen are such as to make the number of drifts, chutes, etc., the same for each.

Plotting the Data—The cost data thus obtained may now be tabulated in the manner shown on page 75. From these figures the curves on the graph may be plotted. On this graph four curves are shown. One shows transfer development costs per sq.ft. of stope (the solid line curve) and the other three (broken lines) show the value of the ore left per sq.ft. of stope. The intersection of each of the "Value of the ore left per sq.ft. of stope" curves with the "Development costs per sq.ft. of stope" curves (i.e., points A, B, and C) gives the optimum draw-point spacing. For example, with $2 ore the optimum distance between draw points is 40 ft. With $2.25 ore the optimum distance between draw points is 37.5 ft. With $2.50 ore the optimum distance is 35.5. The more valuable the ore the closer the spacing.

Savings Due to Proper Draw-Point Spacing—If it be assumed that a mine is now operating on $2.25 ore with draw points spaced at 20-ft. centers, with a block height of 300 ft., and that 12.5 cu.ft. of solid ore equals 1 ton, the present cost per sq.ft. of stope may be estimated as in Table I below from the curves on the graph.

The costs for the proper spacing of draw points on 37.5-ft. centers, as determined from the graph, for $2.25 ore are given in Table II below.

The savings per ton mined due to 37.5-ft. draw-point spacing as compared to 20-ft. draw-point spacing= (20.2−16.9)=3.3c. The savings per day on a 10,000-ton basis will be $330. The savings per year on a 300-day basis will be 300 x $330=$99,000.

Table I

Value of ore left per sq.ft. stope	=$1.03
Transfer development cost per sq.ft. of stope	=$3.73
Total cost for 1 sq.ft. of a stope 300 ft. high	=$4.76
Tonnage mined per sq.ft. for a 300-ft. high stope = (300+12.5)−0.46 (0.46 is the tonnage left)	=23.54
Cost per ton mined = $4.76÷23.54	=20.2¢

Table II

Value of ore left per sq.ft. of stope	=$1.95
Cost of development per sq.ft. of stope	=$1.95
Total cost for 1 sq.ft. of a stope 300 ft. high	=$3.90
Tonnage mined per sq.ft. for a stope 300 ft. high= (300+12.5)−0.87 (tonnage left)	=23.13
Cost per ton mined = $3.90÷23.13	=16.9¢

Reflections From Washington

(*Continued from page 85*)

self and because her domestic production is off. The statistical position of silver and the attitude of WPB are given on page 94.

Relief for Closed Mines

THERE is some question in the minds of Washington officials as to whether the closing of the gold mines by Order L-208 really accomplished its purpose of saving substantial amounts of strategic materials and of providing additional manpower for mining the critical base metals. There are many who believe that the net result was merely hardship for the closed mines and their employees. Among those who hold this view is Senator Murray, who introduced Senate Bill 344, a relief measure. Mines forced to close because of the war will be relieved of certain contractual obligations if the bill becomes a law. It provides that operators may petition the courts for relief and directs RFC to make loans to maintain property and to meet tax obligations.

Hearings before the Senate Committee on Mines and Mining were scheduled for mid-June.

Order P-56 Amended

FASTER HANDLING of requests for emergency repairs for mines was provided by an amendment to Order P-56 made public early in May. A new paragraph has been added to the order in which the emergency procedure is outlined for mines which must obtain materials quickly in case of actual or impending breakdown. The paragraph follows:

"(g-1) Emergency procedure. In case of actual or impending breakdown, application for priorities assistance may be made on form PD-333 or by telegraph, and may be made either to the Washington office or the nearest regional or district office of the War Production Board."

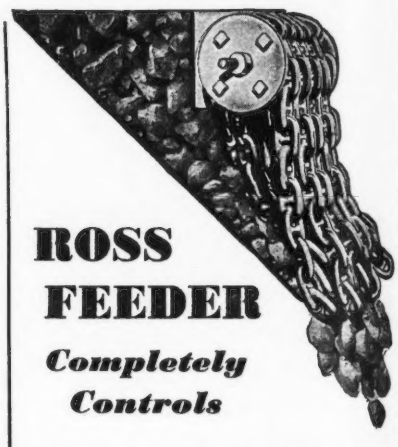
Of the three choices given for applying for help, it is suggested that mines wire Washington—the same procedure used in the past.

Manpower Appeals

THE War Manpower Commission has established machinery by which the 48-hour week order and the employment stabilization plan can be circumvented. WMC Regulation No. 5 establishes the method by which appeals from any of the manpower regulations may be made by both employees and employers.

The new regulation prescribes who may appeal, actions from which workers may appeal, actions from which employers may appeal, notification of the right to appeal, and officers and committees to whom appeals are originally taken. After decisions on the original appeals, further appeals to the regional management-labor manpower committees and to the chairman are possible.

The regulation provides that appeal of an employer from a decision granting one of his workers a statement of availability in no way stays the effect of the decision so far as the worker is concerned, but the officer to whom the appeal is taken may direct that subsequent cases involving other workers of an employer and raising identical issues may be suspended pending final settlement of the issues. There is a similar provision protecting employers who are satisfied with certain decisions from which workers may appeal. In



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all other cases the taking of an appeal stays the action appealed from, unless the chairman of the committee to whom the appeal is taken specifically directs otherwise.

Additional Copper Premium

NOT MUCH is expected in the way of increased copper production as a result of the new premium prices made available to small mines. It is feared that a provision to the effect that settlement with producers based on the special premium will not be made if the program is terminated before July 31, 1945, will prove to be a "stopper."

Small mines, to be eligible for the special premium, must have produced less than 2,000 tons of copper in 1942 and must require increased revenue to get maximum production. Payment will be by Metals Reserve Co. at rates specified by the Premium Price Plan quota committee, which will consider the case of each mine individually. Either the special quota or the special premium rate may be increased or decreased at any time or revoked on 30 days' notice.

Tangle Over Taxes

AS PREDICTED in *Reflections* two months ago (*E.&M.J.*, April, p. 133), Chairman Doughton of the House Ways and Means Committee was not able to squelch the Ruml Plan for putting taxpayers on a current basis. After reconsideration, the committee reported out a bill providing for this feature but containing a complicated provision for abating 25 percent of a year's tax liability instead of the 100 percent contemplated in the Ruml Plan. This was passed by the House but met an ignominious fate in the Senate Finance Committee, which wrote a new bill which was essentially the Ruml Plan, modified to prevent the beneficiaries of "windfall" income in one of the past two years from escaping tax liability on that year's income. This bill was passed by the Senate.

Probably the House would have accepted the Senate bill by a small margin if President Roosevelt had not written a note implying that he would veto a bill which failed to discriminate between small and large taxpayers on tax abatement. After this action, the House refused to concur by a small margin and the bill was referred to a conference committee. In conference, after considerable pulling and hauling, a compromise was finally worked out which would put all taxpayers on a current basis beginning July 1, would forgive 100 percent of a year's tax liability to taxpayers whose tax amounted to $50 or less, and 75 percent to taxpayers whose tax exceeded $50. In both cases the tax forgiveness is to apply to the year, 1942 or 1943, in which the tax liability is the lesser.

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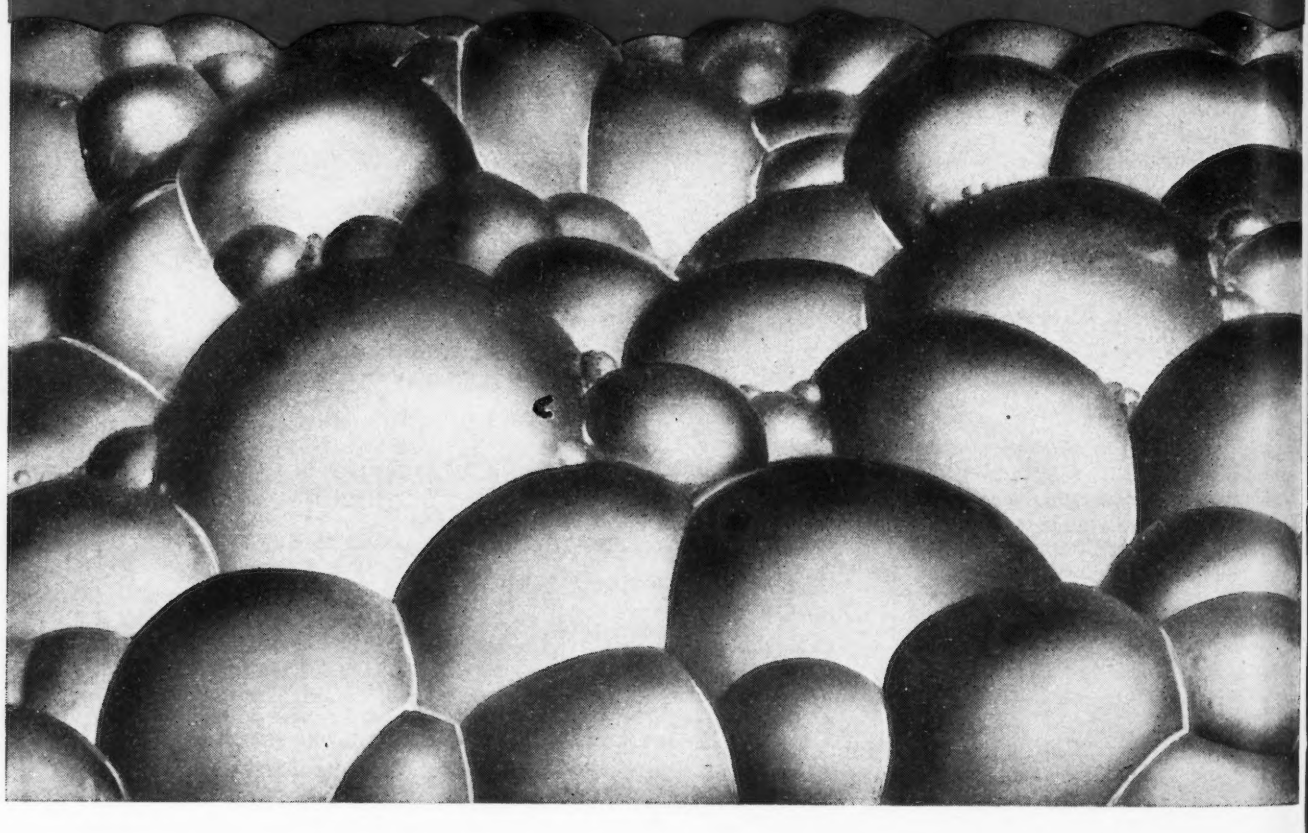

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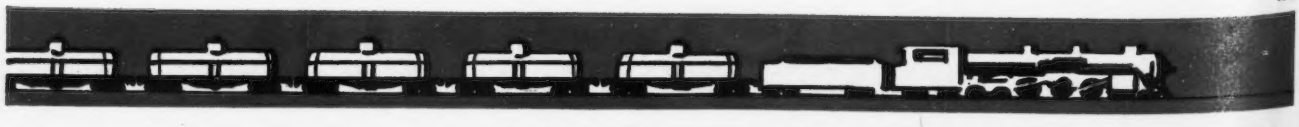
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